Lithographer

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Although the words "he," "him," and "his" are used sparingly in this manual to enhance communication, they are not intended to be gender driven nor to affront or discriminate against anyone reading *Lithographer*, NAVEDTRA 10451.

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Naval Education And Training Program Management Support Activity

LITHOGRAPHER

NAVEDTRA 10451

1987 Edition Prepared by
LICM Joseph C. Martin, Jr., USN

PREFACE

This rate training manual (RTM) is a self-study package that will enable the enrollees to gain information which will help them fulfill the requirements of their rating.

Designed for individual study and not formal classroom instruction, the RTM provides subject matter that relates directly to the occupational qualifications of the Lithographer rating. The NRCC provides the usual way of satisfying the requirements for completing the RTM.

This training manual was prepared by the Naval Education and Training Program Management Support Activity, Pensacola, Florida, for the Chief of Naval Education and Training. Technical assistance was provided by Mr. David Jones, NPPSMO, WNY, Washington, D.C.; LICM William Portt, USN, and LICS Robert Carr, USN, Defense Mapping School, Fort Belvoir, Virginia; LICM Robert Hoffman, USN, CINCLANTFLT, Norfolk, Virginia; LICS David Murray, USN, U.S. Naval Activities, United Kingdom; LIC Robert Ford, USN, USCINCPAC, Pearl Harbor, Hawaii; LIC Donald Fachico, USN, USS Yellowstone (AD41); and LIC Robert Crain, USN, NETPMSA, Pensacola, Florida.

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THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

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CHAPTER 1

THE NAVY LITHOGRAPHER

Printing is one of the world's largest industries. It directly influences all of our lives each and every day through our educational, industrial, professional, religious, military, and domestic needs. Printing is so integrated into our lives that it is almost impossible to imagine ourselves without it.

Until about 560 years ago, all books were hand-lettered by men called scribes, who took years to complete even a single volume. Around A.D. 1423, reproduction was accomplished by one scribe sitting reading aloud from the master copy of a book while others around him copied it word for word. This method of reproduction could produce only a few copies of a book.

The production of hand-lettered manuscripts was distinctly limited. There had to be a quicker method of reproducing books. In an early attempt at printing, workers carved the lettering for an entire page on a block of wood, inked the block, then printed the pages. Even though this crude method of printing increased the number of copies that could be produced, it had drawbacks. The woodcarvers worked long hours for many days, hand-cutting the wooden blocks. The lettering was fragile, and these carved blocks served no purpose after the required number of copies had been printed.

Johann Gutenberg invented a mold for casting separate metal letters, called type. These raised letters could be combined, or "set," to form words and lines of words. When enough lines to fill a page were set, they were locked together, put into a press and inked, then printed on paper. The use of set type greatly increased the speed of reproduction and allowed early printers to reuse the type for other pages or jobs. Gutenberg's invention marked the beginning of printing as we know it today.

Printing has grown in stature and importance until it is a great, modern, indispensable industry. Modern production requires a speed and an accuracy unknown to the early printers. To meet these demands, today's printers use several different methods of reproduction.

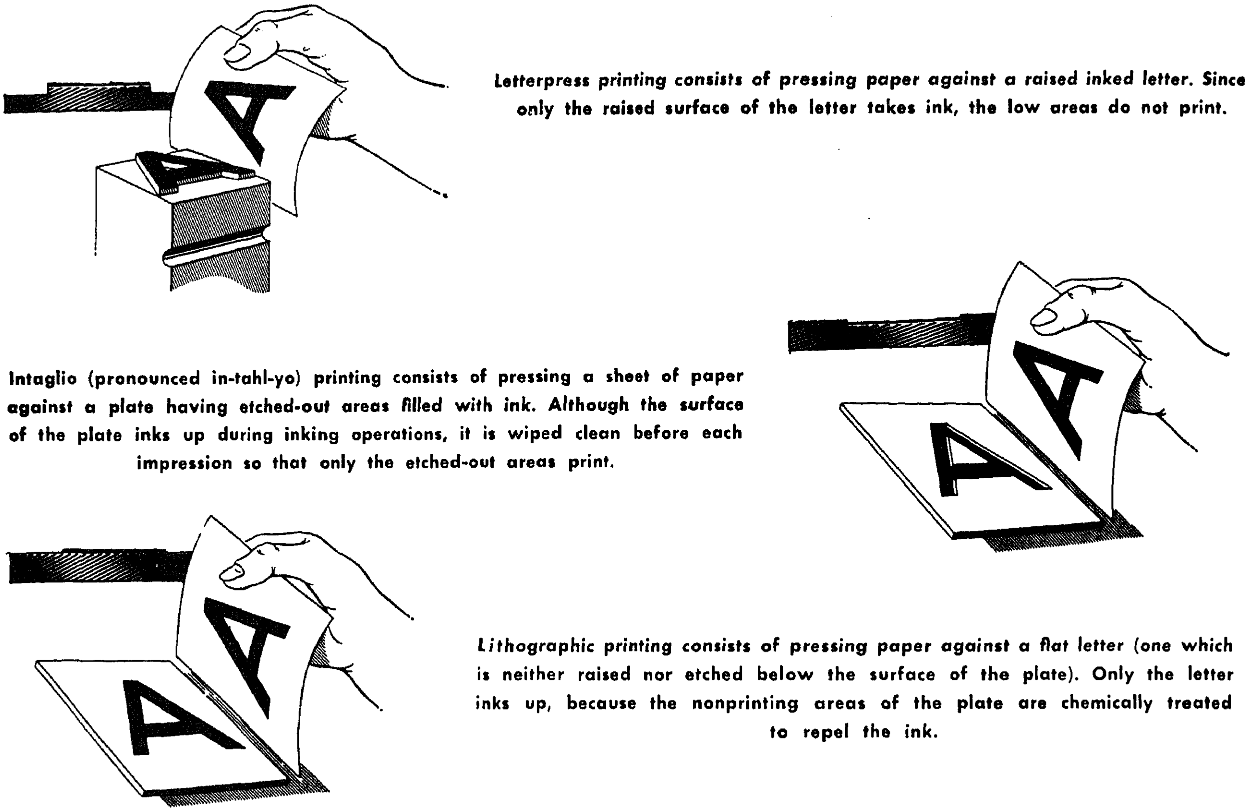
Gutenberg's process, known as LETTERPRESS or relief printing, is still commonly used today. Other processes are intaglio and lithographic printing. Figure 1-1 shows the principles involved in each of these printing processes.

BASIC PRINCIPLE OF LITHOGRAPHY

Lithography is based on the simple principle that oil will not mix with water. The following example will help to make this clearer.

Suppose you added some red dye to a pan of water. What would happen? The water would turn red. But if you poured some thin oil paint into the pan, the water would not be affected—because oil and water will not mix. Since the two will not mix, the color would float on the surface of the water in a kind of greasy design. If a sheet of paper were placed on the water, it would absorb the color, and the design would thus be transferred to the paper.

This system is used in binderies for "marbling" the edges of books. The bookbinder pours oil paints into a container of water and stirs them to produce various designs. The bookbinder then clamps the book tightly so that the colors will not seep between the pages and touches the edges of the book to the colors on the water. The paper absorbs the colors, and a beautiful marbled design is produced.



Letterpress printing consists of pressing paper against a raised inked letter. Since only the raised surface of the letter takes ink, the low areas do not print.

Intaglio (pronounced in-tahl-yo) printing consists of pressing a sheet of paper against a plate having etched-out areas filled with ink. Although the surface of the plate inks up during inking operations, it is wiped clean before each impression so that only the etched-out areas print.

Lithographic printing consists of pressing paper against a flat letter (one which is neither raised nor etched below the surface of the plate). Only the letter inks up, because the nonprinting areas of the plate are chemically treated to repel the ink.

57.2

Figure 1-1.—Comparison of the three main printing processes.

The marbling process is similar in principle to lithographic printing. However, because the water is fluid, the image is unstable, and it is therefore impossible to produce a series of prints that are exactly alike in design. Since a stable image is required for producing like designs, the image must be fixed or anchored to a solid material, such as the lithographic stone or plate.

INTAGLIO PRINTING

The intaglio printing process is the exact opposite of letterpress printing. In this process, the letters or designs to be printed are etched into the surface of a metal plate. When the plate is inked, the etched areas form tiny reservoirs of ink. The surface of the plate is then wiped clean so that when paper is forced against it, only the ink-filled image is reproduced. (See fig. 1-1.)

The images for engraved stationery, paper money, and postage stamps are reproduced by the intaglio process. Rotogravure is also a form of intaglio printing. The magazine section of many of our Sunday newspapers and parts of mail-order catalogs are printed by the gravure process.

LITHOGRAPHIC PRINTING

Lithography is another important printing process. It is also known by such names as planography and photo-offset. This type of printing is different from both letterpress and intaglio printing, yet the results are similar. In lithographic printing, the design is either produced by hand or reproduced photographically on a flat plate.

As you can see in figure 1-1, the design is neither raised nor sunken. It is the same height as the blank, nonprinting areas around it. This perhaps leads you to wonder why the nonprinting areas don't ink up along with the image when the plate is inked. They undoubtedly would, if they were not chemically treated to repel the ink. As a result, only the image takes the ink, and the nonprinting areas remain clean, showing up on the paper as blank space.

OTHER REPRODUCTION PROCESSES

In addition to the three main types of printing just discussed, there are other reproduction processes, such as mimeographing, gelatin duplicating, silk screening, and quick copying. Although these processes are not considered to be *printing* in the strictest sense, the quick copying process will be discussed further in another chapter.

OFFSET LITHOGRAPHY

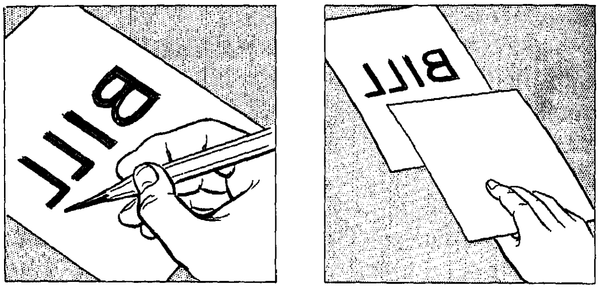
Offset lithography is a practical outgrowth of old-fashioned stone lithography. Stone lithography, of course, is not new. It was invented in Europe in 1796 by a man named Alois Senefelder. He found that if he wrote with a grease pencil on a certain type of stone and then wet the stone with water, he could apply ink to the grease image without inking up the rest of the stone. He could then make as many prints as he desired by simply wetting and inking the stone before each impression. He called the process lithography, which means "stone writing."

For many years after Senefelder's discovery, the stone was used exclusively as the master plate in making lithographic prints. However, with the introduction of zinc and aluminum plates, the popularity of the stone gradually decreased, and today, it is obsolete.

The original lithographic stones were limestones that were porous enough to hold water and grease; yet they provided a smooth working surface. The stones came in sizes up to 44 by 62 inches and were often from 3 to 5 inches thick. Such stones could weigh more than half a ton.

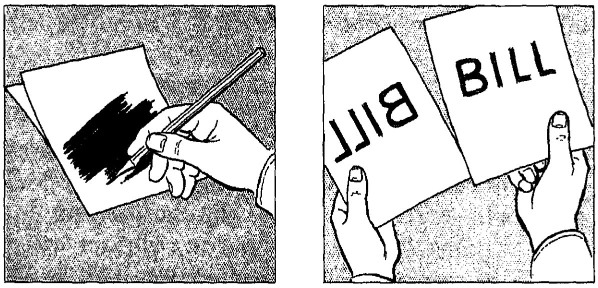
Printed matter was drawn on these stones by hand. Designs were hand-drawn in reverse so that the prints would read forward. To understand this better, take a look at the experiment shown in figure 1-2.

Here's how it works: using a soft pencil, print a word backwards on a sheet of paper. Then lay another sheet of paper over it, and rub the back of the second sheet with your pencil as shown in figure 1-2. You will see that the word will transfer to the second sheet—reading forward. Even complex lithographic designs were reversed in this same manner.



USING SOFT PENCIL WRITE A WORD ON PAPER IN REVERSE

COVER IT WITH ANOTHER SHEET OF PAPER



RUB THE BACK OF THE SECOND SHEET WITH YOUR PENCIL

AND THE WORD WILL TRANSFER TO THE SECOND SHEET READING FORWARD

57.3

Figure 1-2.—The principle involved in reversing designs for lithographic printing.

Over the past 40 years, lithography has become one of the fastest and most economical means of reproduction, and it is still growing in both size and scope. So you've made a good choice in deciding to become a Lithographer. You will find the field growing in importance in the Navy too—just as it is in civilian life.

INTRODUCTION TO OFFSET PRESSES

Offset presses are viewed as the cornerstone of the lithographer's environment. From the time offset presses were first introduced into the field of lithographic printing, they increased production and thus provided better service. Through innovations and with progress, offset presses have become more functional and efficient tools to the lithographer.

FLATBED PRESSES

Lithographic printing, as you have just seen, requires moistening the stone and inking it before each impression. These operations were done by hand on the first crude lithographic presses. Figure 1-3 shows one of these presses, which were known as "flatbed" presses because the lithographic stone rested on a flatbed. Two printers had to work hard to turn out 1,000 impressions a day on such a press.

CYLINDER PRESSES

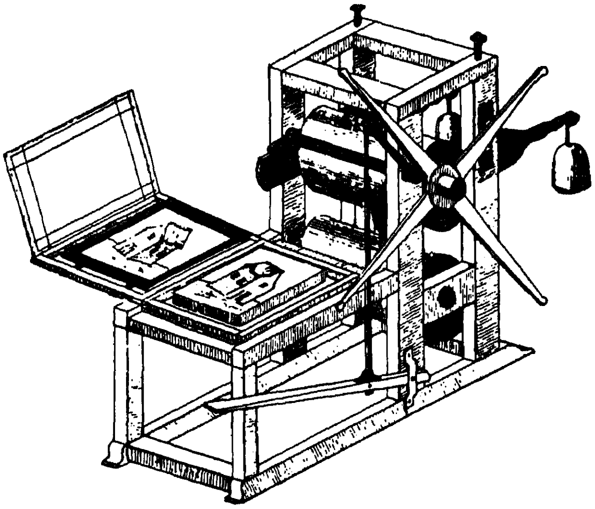
Later lithographic presses were equipped with automatic dampening and inking rollers, as well as a cylinder for carrying the paper. The stone was placed on the flatbed, which shuttled back and forth alternately under the dampening and inking rollers and the impression cylinder which carried the paper. The cylinder revolved at the same rate of speed as the bed and pressed the paper against the stone to make the impression. These automatic cylinder presses increased production to 5,000 impressions a day. They were the forerunners of the high-speed offset presses in use today.

ROTARY PRESSES

Lithography quickly became a favorite means of producing artwork, pictures, maps, and posters in full colors. But the regular black-and-white lithographic process was too slow and too expensive to offer any real competition to the already established letterpress process. Therefore, the black-and-white lithographic process was viewed with interest but little enthusiasm.

However, lithography gained ground with the coming of zinc and aluminum plates. When properly treated, these plates could hold grease and water just as well as the lithographic stone. But unlike the stone, they were light and pliable, and could easily be fastened around a cylinder.

Experiments with zinc and aluminum plates led to the development of the rotary press. This press consisted of two cylinders that rotated in opposite directions. The plate was carried on one cylinder and the paper on the other. They were synchronized to meet and contact each other and thus produce an even impression. This new type of press printed approximately 1,000 impressions per hour.



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57.4X

Figure 1-3.—An early flatbed lithographic press.

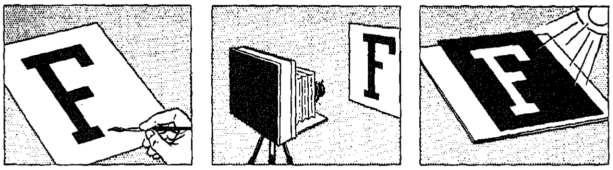
PHOTOGRAPHY

Soon after the development of photography in 1839, lithographers began using it to produce images on their stones. By 1860, zinc plates produced with the aid of a camera were being successfully used. This working partnership between photography and lithography came to be known as photolith or photolithography.

However, in spite of its early advances, photography was not generally used for producing lithographic plates until the beginning of the twentieth century. Photolithography developed quickly in past years and is now used extensively both in the Navy and outside (see fig. 1-4).

OFFSET PRESSES IN OFFSET LITHOGRAPHY

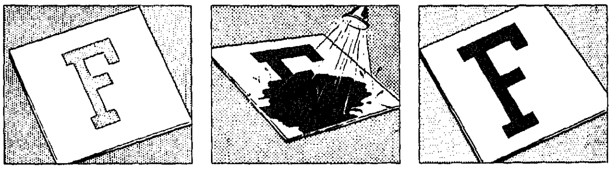
Most of the printing discussed thus far has been *direct* printing—that is, the impressions are made on the paper directly from the stone or plate. In 1905, tin decorators used an indirect (offset) printing process, yet no serious consideration had been given to applying offset printing to paper. In 1906, Ira Rubel, a lithographer from Nutley, New Jersey, conceived the idea of an offset press designed specifically for printing.



THE WORK IS DRAWN ON A PIECE OF PAPER . . .

. . . . . AND PHOTOGRAPHED TO PRODUCE A NEGATIVE . .

A SENSITIZED METAL PLATE IS EXPOSED TO BRILLIANT LIGHT THROUGH THE NEGATIVE.



WHERE THE LIGHT STRIKES, THE EMULSION IS HARDENED ON THE PLATE TO PRODUCE . . . .

. . . . A LATENT IMAGE WHICH IS COVERED WITH DEVELOPER AND WASHED OFF . . . .

THE UNHARDENED EMULSION SOAKS OFF THE PLATE, LEAVING THE HARDENED IMAGE . . . .

57.5

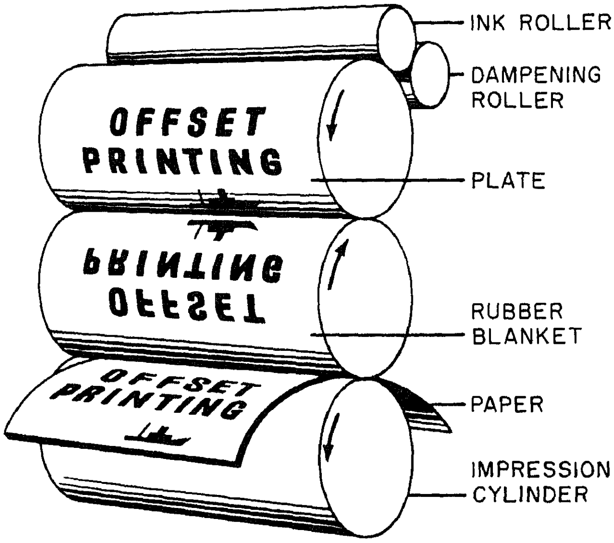
Figure 1-4.—Photolithographic process of platemaking.

It all started one afternoon while Rubel was watching paper being fed into a cylinder press. The pressman missed feeding a sheet, and the plate made its impression on the cylinder packing. Naturally, the next sheet fed through was printed on both sides. (The plate pressed the paper against the cylinder packing, and the fresh ink left there by the previous impression was transferred onto the back of the sheet.)

This gave Rubel an idea, and, shortly thereafter, he came up with a new type of press that offset the image onto the paper instead of printing it directly on the paper, as before.

Rubel's press had an extra cylinder that was covered with a rubber blanket. The image from the plate was printed first on this blanket and then was transferred from the blanket to the paper stock. This press brought a new versatility to lithographic printing. Since the stock did not contact the plate directly, less water was transferred to the paper, and that made it possible to print on a greater variety of stock and to use less fountain solution in the press. The resiliency of the rubber blanket also enabled lithographers to print on stock having a rough or coarse surface, and it reduced wear on the plate, thus lengthening the life of the printing image.

Figure 1-5 shows a simple diagram of some of the parts of the offset press. You should understand it, because you will be working almost exclusively with this type of press.



57.6

Figure 1-5.—Simple diagram of the printing unit of an offset press.

The press includes these parts:

- An ink roller
- A dampening roller
- Three large metal cylinders

NOTE

There are other press parts not shown that will be discussed in later chapters. Remember, figure 1-5 is only a *simple* diagram.

The plate is attached to the top cylinder (the plate cylinder), as shown in figure 1-5. The rubber blanket is attached to the center cylinder (the blanket cylinder), and the bottom cylinder (the impression cylinder) carries the paper through the press, forcing it against the rubber blanket to make the printed impression.

When the press is running, the cylinders revolve and the plate contacts first the water-dampening roller, then the inking rollers, and finally the rubber blanket. The dampening roller thus keeps the nonprinting areas of the plate wet so that they will not take ink when the plate contacts the ink rollers. As a result, only the image is inked. After the plate contacts the ink rollers, it contacts the blanket cylinder, transferring the inked image to the blanket. The blanket, in turn, offsets or prints the wet image on the paper, which is forced against it by the impression cylinder.

You will recall from the experiment described in figure 1-2 that in direct lithographic printing, the image was drawn on the plate in reverse so that it would read "forward" when the job was printed on the paper. Offset printing works just the opposite. The image reads forward on the plate, backward on the blanket, and forward again on the paper. Look at figure 1-5 again. It illustrates this point very clearly.

Lithographic processes are called by many different names—planography, photolith, photolithography, and so on. These names may sound confusing, but they needn't be, because most of them are just variations of the same process. If a job is printed on an offset press from a lithographic plate, it is called an offset printing job. If photography is used in making the plate, the job becomes photo-offset printing. However, the process is not photo-offset or photolithography unless photography is involved.

THE WHOLE PICTURE

By now you are probably full of isolated bits and pieces of information on lithography. So let's fit the pieces together and see just what goes on in a lithographic plant.

Planning and Copy Preparation

Planning the work is the first step. The lithographer must study each job and decide how it can best be produced with the equipment on hand. Sometimes the work may be sketched or laid out in rough visual form to show the positions of the type and illustrations on the page. A specification sheet may also be used to show such pertinent information as the color of the ink, the kind of paper to be used, the size of the page, and the number of copies required.

The second step is called copy preparation. It consists of such operations as drawing illustrations, retouching photographs, composing the text, and pasting all the work together or assembling it for the camera.

From Copy to Stripping

The third step takes place in the camera room. There the camera operator photographs (copies) the work, processes the film (negative), and sends it to the stripping department. There it is examined for defects and is corrected or retouched if necessary. Several negatives may then be stripped (taped) together in their proper printing positions on a sheet of yellow-orange paper, called goldenrod. Once the negatives have been joined to the goldenrod, the unit is then called a *flat*. Windows are cut in the goldenrod to expose the printing (transparent) areas of the negatives. These areas will then print on the plate, but the areas masked off by the goldenrod paper will not.

Making the Plate

The next step occurs in the plate room. There the platemaker places a thin plate that has been coated with a light-sensitive solution in a vacuum frame and positions the flat over the plate. Then the plate is exposed to a bright light.

During the exposure, the light passes through the transparent areas of the negatives and hardens the coating on the plate wherever it strikes. After the operator removes the plate from the vacuum frame, it is processed with chemicals that dissolve the unhardened areas of the coating, leaving the light-hardened areas on the plate as the printing image.

Going to Press

The plate is then sent to the pressroom, where it is clamped on the cylinder of the offset press. The job is printed. (You have already seen in figure 1-5 how impressions are made on this press.)

Bindery Operations

When the job leaves the pressroom, it is taken to the bindery, where it is folded, stitched, cut, trimmed, padded, or punched, as required. This is the final operation.

NOTE

In large printing facilities there is a specialist for each operation in photolithography. But, as a Navy Lithographer, you must be able to perform all of these operations. Of course, you might do only camera work or platemaking at one time and nothing but press work at another time. But whatever your specialty, you will still need a working knowledge of all the operations in your shop.

OFFSET LITHOGRAPHY IN THE NAVY

Offset lithography was introduced to the U.S. Navy in 1940 by the installation of a Multilith press, Model 296, aboard USS *Maryland* (BB-46). Before that time, printing had been done on letterpress equipment by personnel in the Printer rating. The first printers in the Navy were referred to as "ship's printers." That title dates back to the 1860s. In 1921, the "ship's printers" rating was changed to that of Printer, establishing third class to chief petty officer rates within the Printer rating.

The transition from letterpress to offset equipment was not enthusiastically welcomed by some old-timers in the Navy. When asked to work with the new lithographic process, the old-timers were apt to think that anything could happen and probably would when they attempted to do a job using this process.

With the introduction of offset printing in the Navy, the Lithographer encountered problems with maintaining the correct ink and water balance on the presses. Also, the light-sensitive coatings used on the plates varied in both density and sensitivity. The weather conditions and the climate affected materials, equipment, and the lithographic process as ships moved from one climate to another in short periods of time. It was difficult to maintain proper temperature and humidity control in shops without air conditioning. This early offset printing was done by trial and error, with each shop developing its own chemical formulas and techniques.

Progress continued in lithography and offset printing, and in 1943, 17-inch by 22-inch AFT Chief Webendorfer offset presses were installed aboard five new amphibious force flagships.

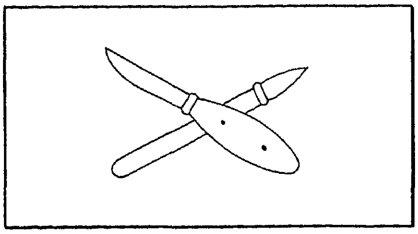
The offset process/lithography proved sufficient for the Navy in 1944 when the invasion of France gave the new process a severe test. Two great task forces were scheduled to strike at Normandy. The western force, made up of U.S. units, consisted of two assault forces and a follow-up force—in all 2,479 ships. The preparations for the big offensive were tremendous. Unprecedented quantities of printed materials, including maps, charts, aerial photographs, and operational data, were needed.

USS *Ancon* (AGC-4) was the only ship in this massive armada that had a complete lithographic shop, so all attention was turned to it. The *Ancon's* print shop was faced with not only supplying nearly all of the printing needs of the entire fleet, but the printing had to be done quickly. The veteran print shop crew and the new equipment rose to the occasion and met the challenge.

Offset printing also came of age ashore in the Navy. At the outbreak of World War II there were only two naval shore activities equipped to produce offset printing—the Naval Hydrographic Office and the Naval Communications Center. Needless to say, the situation quickly changed. Lithographic equipment and supplies began pouring in to five depots from Philadelphia to Guam. A school was also set up to train men to operate the new equipment. Soon the Navy had advance-base units in Guam, London, Pearl Harbor, Melbourne, and Algiers.

In 1948 the Lithographer (LI) rating was established. Chosen as the specialty insignia were two tools of early lithography: a litho crayon holder and a scraper knife that was used to sharpen or clean up the crayon image on the stone. (See fig. 1-6.)

A gradual phasing-out of the Printer (PI) rating was begun and continued until the mid-1950s, when the few remaining PIs were converted to LIs. Another milestone in Navy offset printing occurred about the same time when, in 1956, the first large offset press, a 22-inch by 36-inch Harris, was installed aboard USS *Saratoga* (CVA-60).



3.10

Figure 1-6.—Crossed litho crayon holder and scraper knife make up the Lithographer rating insignia.

Today, amphibious force flagships, aircraft carriers, destroyer and submarine tenders, and repair ships all carry fully equipped and up-to-date offset print shops. Aboard ship, you will often find the print shop situated close to the photo lab and drafting shop so that these units can assist one another in performing their related duties. In many cases, the Chief Lithographer will also be in charge of these other shops. Ashore, the print shop usually operates under the activity's administrative office.

DUTY AS A NAVY LITHOGRAPHER

Lithographers serve ashore as well as afloat in the larger ships of the fleet. The LI operates and maintains all lithographic equipment used by the Navy. Besides general printing, the LI's work may include reproduction of such specialized items as charts, grids, surveys, operation orders, and so on. Their work is often classified, and a security clearance involving personal records checks or background investigations may be required.

As a Lithographer Third Class, you might be ordered to a billet aboard a command-type vessel (LCC), an aircraft carrier (CV, CVN), or one of the many types of auxiliaries (AD, AR, AS). If you are ordered to a billet ashore, your orders may be to a flag command (such as CINCLANTFLT or CINCPACFLT), to a naval station (such as Jacksonville, Florida, or Pearl Harbor, Hawaii), to a communications unit (such as OPNAV), or to an intelligence center (such as FICPAC).

When you advance to Lithographer Second Class, you might be assigned to a leading petty officer billet aboard a ship such as an amphibious assault ship (LPH, LHA). Of course there are many LI2 billets aboard ships which are not the leading Lithographer for that command. Orders to shore duty may take you to staff duty in Washington, D.C., or Charleston, South Carolina. Overseas shore billets for an LI2 include a communications unit in London, a naval station in Iceland, a fleet support activity in Japan, to name a few.

LIs often work closely with Photographer's Mates, Illustrator Draftsmen and Engineering Aids. If a ship or station newspaper is published, LIs may also deal with personnel of the Journalist rating.

Personnel with a good working knowledge of basic mathematics, physics, and mechanics are well-suited to lithography. A hobby or an interest in photography, printing, optics, design, and so on, indicates that a person would probably do well in the Lithographer rating.

TRAINING AVAILABLE

It is impossible to list all the ways in which you, as a Lithographer, will serve the Navy. Much of your duty will concern the routine production of all types of printed materials needed to operate an organization as large as the Navy. There will also be those not-so-routine times when you will be required to work long hours to complete a priority job or you may be assigned to a special billet on temporary assignment somewhere, possibly living and working under difficult conditions.

But the most important duty you will have as you advance up the ranks will be as a leader. As a petty officer in the Navy, you enter the field of military leadership. Leadership, it has been said, is getting people to do what you want, because they want to do it. There are no hard and fast rules that can be applied to dealing with people, and there aren't any courses or books that alone will make you an effective leader. Of course, books and courses in human relations and personnel management will help you to develop the qualities of a good leader.

For the most part, your ability to work with and to lead people will depend on the learning you gain from your experiences and the application of plain, old-fashioned common sense. Keep in mind that nearly everyone, especially the new person in the Navy, wants to do good work. Your job as a petty officer will be to provide personnel with the instruction and guidance needed to continue to do a good job. To give them this and to ensure that they accept it, you will have to gain their confidence. This is done by showing them that you care about them and their problems, by treating them with consistency and fairness, and by the professional skills you demonstrate.

To be sure—leadership is not easy. You will have to develop it. Every approach you take as a leader won't be the best one. The time and effort that you expend to become a leader will be well spent and will benefit you and the Navy.

RATING INFORMATION

Your growth in professionalism and advancement will depend greatly on the proper use of certain manuals provided by the Navy. In addition to this Lithographer manual, you should also use the appropriate manuals listed below for your particular paygrade. Always make sure you have the latest edition of the manual!

- E-4, *Military Requirements for Petty Officer Third Class*, NAVEDTRA 10044
- E-5, *Military Requirements for Petty Officer Second Class*, NAVEDTRA 10045
- E-6, *Military Requirements for Petty Officer First Class*, NAVEDTRA 10046
- E-7, *Military Requirements for Chief Petty Officer*, NAVEDTRA 10047

DEPARTMENT OF DEFENSE SCHOOLS IN PHOTOLITHOGRAPHY

Lithographers may request a quota to attend resident training at the Defense Mapping School (DMS), Fort Belvoir, Virginia, in areas of their field. The areas of training include

- Navy/Air Force Basic Lithographer (NAAFBL), which gives the student a basic course of hands-on training in the whole scope of the lithographic field in about 91 academic days.

- Basic Offset Printing (BOP), which provides the student with basic hands-on training with lithographic equipment (small- and medium-size offset presses and direct-image platemakers) in about 44 academic days.

- Basic Photolithographic Processes (BPLITP), which gives the student a basic course of hands-on training in the photographic scope of the work required for the Navy Lithographer in about 70 academic days.

- Reproduction Equipment Repair Course (RERC), which gives the student advanced hands-on training in repair of lithographic equipment (small and large offset presses and process cameras) in about 75 academic days. The Navy Enlisted Classification (NEC) Code LI-3601, Lithographic Equipment Repairman is given for successful completion of this course.

- Advanced Lithographer (ALITH), which gives the student advanced hands-on training in identified weak areas of previous training or experience in about 25 to 30 academic days.

SOURCES OF INFORMATION

Besides training manuals, the *Bibliography for Advancement Examination Study*, NAVEDTRA 10052, lists other official publications on which you may be examined. You should study not only the required sections but also the nonrequired sections—become as familiar as possible with all the related publications you can.

One of the most useful things you can learn about a subject is how to find out more about it. No single publication can give you all the information you need to perform the duties of your rating. You should learn where to look for accurate, authoritative, up-to-date information on all subjects related to the military requirements for advancement and to the occupational standards of your rating.

REFERENCE PUBLICATIONS

You will find regulations covering the handling and custody of classified materials in the most recent copy of *Department of the Navy Information Security Program Regulation*, OPNAVINST 5510.1.

You should also become familiar with the publications *Department of the Navy Publications and Printing Regulations*, NAVSO P-35, and *Government Printing and Binding Regulations*, which is published by the Joint Committee on Printing. These publications contain rules and regulations applicable to all naval and Government printing.

The Navy Stock List of Forms and Publications, NAVSUP 2002, lists all standard Navy forms available through regular supply channels. *Forms Management Program Guidance*, OPNAVINST 5213.1B, may be used as a guide in designing and preparing new forms.

These and other basic Navy publications relating to printing and lithography are listed in the reading list at the front of this book. Additional books and magazines for reference reading are listed in appendix I.

The books mentioned above may be obtained from the educational services officer of your ship or station or from your leading PO.

INSTRUCTIONS AND NOTICES

The Lithographer should be aware of all Navy instructions and notices that pertain to printing. These notices are usually from one page to four pages long and are included in the Navy Directives System. They supply the latest information regarding printing rules and regulations. The instructions and notices may be obtained from your administration office.

SUMMARY

You have just been introduced to printing and offset lithography. You were also informed about the important part they play in the U.S. Navy as well as in your everyday life. In the chapter that follows, you will be given detailed information about planned reproduction in the field of lithography.

CHAPTER 2

PLANNING REPRODUCTION

As a Lithographer, you will be reproducing existing copy primarily. Copy preparation will not be necessary in most cases, since most of the originals will already be in printable form. All you need is a good, clean original or sample of the job that is to be reproduced. This type of job is called "camera ready." The camera operator will photograph the original to produce the negative that will be used to produce the printing plate.

If the job has never been printed, a different procedure must be followed. New jobs require planning before being put into printed form. The planning and preparations that go into a job are called copy preparation. Copy preparation may include preparing a layout, making a dummy, selecting type styles, preparing the type matter using cold type composing machines, ruling in with pen and ink, and preparing original artwork.

Not all jobs will require the same amount of copy preparation. For example, the program for a change of command ceremony will require considerably more copy preparation than will a single-page form for routine office use. Therefore, more time will be spent on planning some jobs than on others.

Time is time—you can divide it or budget it, but you can't shorten or stretch it—so you should make the most of it. Remember, making the most of time means making every moment count.

Depending on your assignment, your responsibilities in the planning stages of a printing job will vary. However, you need an understanding of all the procedures used when you are planning the printing job. Before you attempt to do a job, analyze it. Look at the job not only in terms of the finished product, but also as a series of steps or operations. Plan each step accordingly to make the most efficient use of time, manpower, equipment, and supplies.

THEORY OF PLANNING

Good planning is a little more than just proper organizing. In planning a job, you must determine the operations involved and estimate the time, personnel, and materials that will be required to produce the job. And you must look ahead to see the problems that are likely to arise in each department and try to work out solutions to these problems before the job gets under way.

In many cases, the petty officer in charge (POIC) is given only an idea of the job and told to decide the best approach to use. The POIC will read the copy to determine its subject matter and then will lay it out in the form that is most fitting. A short announcement might be presented as a bulletin or letter; a lengthy article might be made into a pamphlet or booklet. The purpose of the job is the primary factor in determining its proper physical form.

SELECTING THE PAPER STOCK

Before deciding on the kind of paper to use, you should determine what the job is to be used for. You should also determine who will use the job, under what conditions it will be used, and how much it will be used. The results of this analysis will help you to decide on the materials that should go into the job and the amount of planning that must be done.

If the job is to be saved, you should use a good durable paper. But if it is to be read once and then thrown away, you should use the least expensive stock that will serve the purpose. Thin stocks are generally more economical than heavy stocks. But if the stock is too thin, it might allow the printing to show through on the back. This is objectionable—particularly if the job is to be backed up (printed on both sides).

If you are printing pamphlets or booklets, you must also consider the thickness of the stock. Large publications may call for thin sheets, but small pamphlets generally require a paper whose thickness will give the publication adequate bulk and rigidity.

You must also consider the kind of illustrations to be used. Line drawings and type reproduce well on all kinds of paper regardless of the printing process. But halftones are a different story. They do not reproduce well on all types of paper in offset printing. It is almost impossible to run a fine screen halftone on a rough stock, whereas a smooth stock provides a good surface for the halftone.

Sometimes the printer uses the same stock for the cover of a booklet as for the text, and the two are printed together in the same signature. Signatures will be discussed in detail later in this chapter. Such a cover is known as a self-cover. Self-covers are satisfactory for small pamphlets that are likely to be discarded, but pamphlets that are to undergo considerable handling generally require a separate cover printed on a heavier stock.

You should select a cover stock rigid enough to protect the inside pages, to withstand handling, and to stand up under all kinds of climatic conditions. In addition, the stock should be pleasing to the eye.

When selecting paper stock, keep in mind that offset stocks run well on offset presses but newsprints and some coated stocks are difficult to run.

CHOOSING A PAGE SIZE

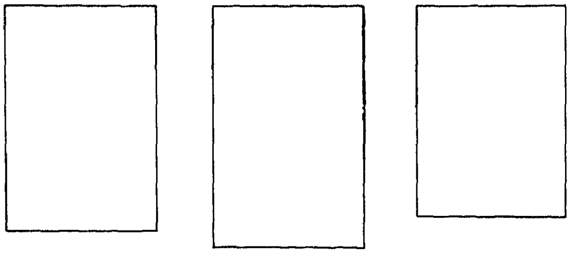
Once you have decided on the paper to use, your next step is to decide on the size and shape of the page. In determining the dimensions of a job, keep in mind the size of the paper stock available, the size of the press, and the binding operations that will follow. For economy, you should try to select a page size that will cut out of the stock sheets with the least amount of waste. It is frequently possible to print two or more pages at a time on the same sheet, but you must always keep in mind the capacity of the equipment when you are planning such a job so that you won't come up with something too large to be handled in the shop.

You must also be on the alert for jobs that are too small for the press. The smaller presses (technically called duplicators, up to size 10 by 15 inches) will take a sheet as small as 3 by 5 inches, but larger presses require a sheet at least 8 by 10 inches. You could run a 3- by 5-inch job on one of the larger presses, but you would have to print it on an 8- by 10-inch sheet. Consequently, there would be a good deal of waste.

To prevent such waste, small jobs are generally assigned to the smaller duplicators, or they are printed two or more up on larger stock. That is, the form is repeated on the plate so that two or more copies can be printed on the paper at each impression. (The forms are later cut apart in the bindery.) Running jobs two or more up in this manner reduces waste and cuts down press time. Sometimes, too, small jobs are ganged or printed together on the same sheet even though the jobs might not be related in any way.

Navy printing and binding regulations require that you select a page or signature size that is a multiple or a division of the basic 8-1/2 by 11-inch sheet; for example, a 17- by 22-inch sheet or an 8-1/2 by 5-1/2-inch sheet.

Printers have found that rectangular forms are more interesting than other forms. (See fig. 2-1.) They often use a rectangular page, for example, that is two-thirds as wide as it is long. This type of rectangle, known as a *regular rectangle*, is very popular because much of our book paper comes in stock sheets that cut out to these rectangular dimensions. As you know,



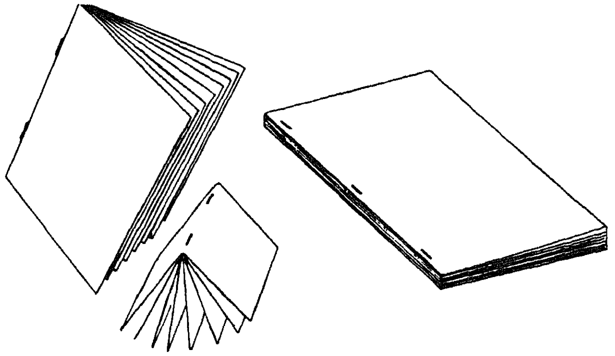
The Regular Rectangle. Its length is approximately 1.5 times its width.

The Golden Mean Rectangle. Its length is approximately 1.6 times its width.

The Hypotenuse Rectangle. Its length is approximately 1.4 times its width.

113.1

Figure 2-1.—The proportions of these rectangles are pleasing to the eye.


Saddle stitched books are stitched along their fold.

Side stitched books are stitched flat along the edge.

57.20

Figure 2-2.—Comparison of side and saddle stitching.

6 by 9 inches and 4 by 6 inches are common page sizes for booklets and pamphlets.

Besides the regular rectangle that has a ratio of 2:3, you can also use the *golden mean rectangle* with a ratio of 3:5 or the *hypotenuse rectangle* with a ratio of 5:7. Of course, you can vary these proportions if necessary in order to arrive at a shape that cuts best from the stock sheet.

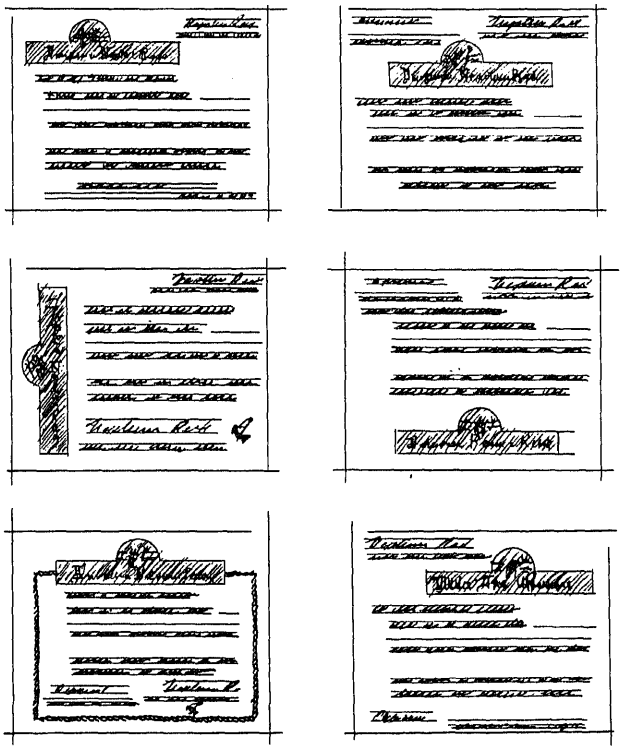


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Figure 2-3.—A series of thumbnail sketches. They should be drawn with a minimum of detail.

A sheet of paper with a number of pages printed on it is called a *signature*. When you are printing a booklet in signatures, you must work out a size that will coincide with the dimensions of the plate. You must also consider the capacity of your camera or folding machine so you won't come up with something too large for your equipment.

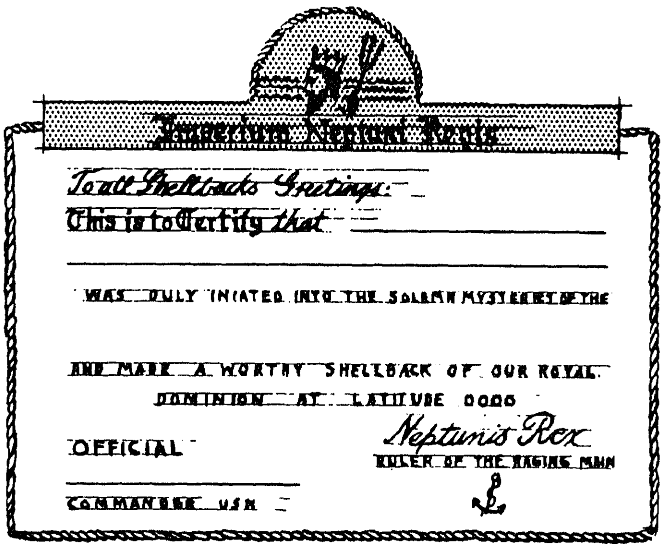
When four or more pages are printed on the same sheet, the sheet can be folded and stitched along the fold, as shown in figure 2-2. This is known as saddle stitching. Saddle stitched books should be planned in multiples of four pages to avoid the occurrence of blanks.

If the pages of a booklet are printed singly, the sheets are generally bound in loose-leaf binders or stitched along the edge (side stitched), as shown in figure 2-2.

LAYOUT

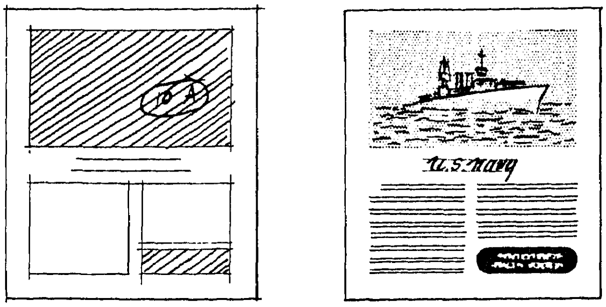
Simply stated, a layout is the plan of a job. The layout shows the arrangement of the type matter and the position of the illustrations. The first step in an original job is to prepare the layout.

The early stages of a layout are in the form of rough preliminary drawings or sketches. Figure 2-3 illustrates a series of thumbnail sketches. The sketch that best fulfills the requirements of the job is smoothed into a rough layout that is drawn to the exact size required. Copy proportions, rules, and boxes should be clean and definite. (See fig. 2-4.) Illustrations and photograph areas


Imperium Neptuni Regis
To all Shellbacks Greetings:
This is to Certify that
WAS DULY INIATED INTO THE SOLEMN MYSTERIES OF THE
AND MADE A WORTHY SHELLBACK OF OUR ROYAL
DOMINION AT LATITUDE 0000
OFFICIAL
Neptunus Rex
RULER OF THE RAGING MAIN
COMMANDER USN

57.22

Figure 2-4.—Finished rough for a small job.



57.23

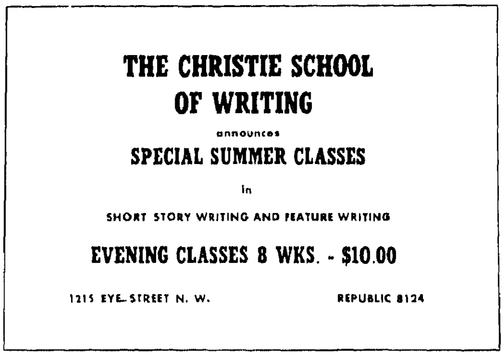
Figure 2-5.—Methods of indicating areas for illustrations on a layout.

should be clearly indicated as shown in figure 2-5.

In addition to giving the personnel in the shop a plan of the job, the layout also provides a detailed sketch that enables the originator to visualize the appearance of the job when it is completed. Changes made to the layout prior to production will save man-hours and materials.

Making a Layout

When you are planning a layout design, look at the intent of the copy. Work of a serious or dignified nature generally calls for a formal layout. You may use informal layouts for other types of work.



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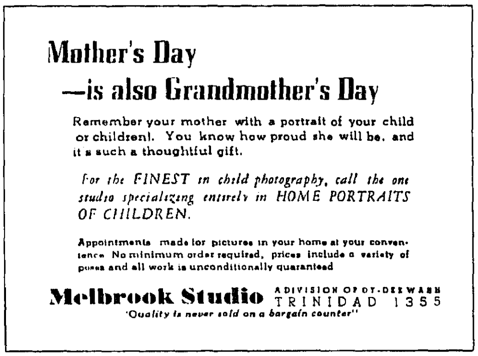
TYPE SET IN FLUCTUATING LINE ARRANGEMENT.



Mother's Day
—is also Grandmother's Day

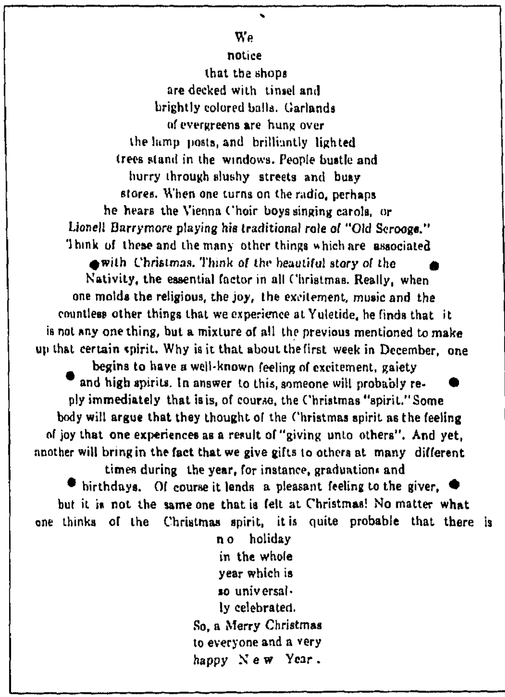
Remember your mother with a portrait of your child or children! You know how proud she will be, and it's such a thoughtful gift.

For the FINEST in child photography, call the one studio specializing entirely in HOME PORTRAITS OF CHILDREN.

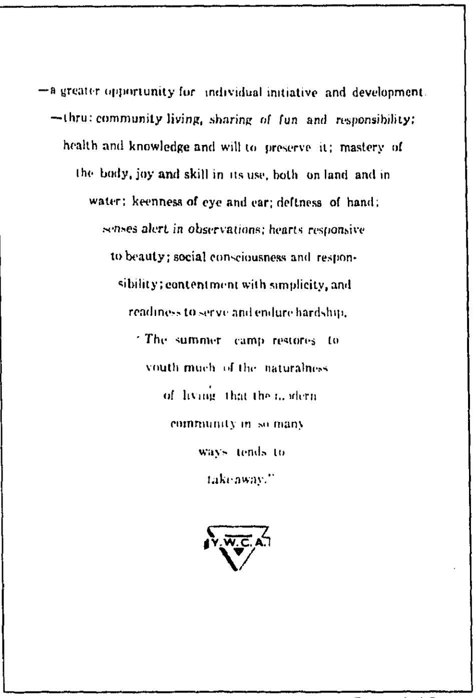
Appointments made for pictures in your home at your convenience. No minimum order required, prices include a variety of poses and all work is unconditionally guaranteed

Melbrook Studio A DIVISION OF DY-DEE WASH
TRINIDAD 1355
"Quality is never sold on a bargain counter"

LINE SET IN A RECTANGULAR BLOCK ARRANGEMENT.



We
notice
that the shops
are decked with tinsel and
brightly colored balls. Garlands
of evergreens are hung over
the lamp posts, and brilliantly lighted
trees stand in the windows. People bustle and
hurry through slushy streets and busy
stores. When one turns on the radio, perhaps
he hears the Vienna Choir boys singing carols, or
Lionell Barrymore playing his traditional role of "Old Scrooge."
Think of these and the many other things which are associated
with Christmas. *Think of the beautiful story of the*
Nativity, the essential factor in all Christmas. Really, when
one molds the religious, the joy, the excitement, music and the
countless other things that we experience at Yuletide, he finds that it
is not any one thing, but a mixture of all the previous mentioned to make
up that certain spirit. Why is it that about the first week in December, one
begins to have a well-known feeling of excitement, gaiety
and high spirits. In answer to this, someone will probably reply
immediately that is is, of course, the Christmas "spirit." Some
body will argue that they thought of the Christmas spirit as the feeling
of joy that one experiences as a result of "giving unto others". And yet,
another will bring in the fact that we give gifts to others at many different
times during the year, for instance, graduations and
birthdays. Of course it lends a pleasant feeling to the giver,
but it is not the same one that is felt at Christmas! No matter what
one thinks of the Christmas spirit, it is quite probable that there is
no holiday
in the whole
year which is
so universally
celebrated.
So, a Merry Christmas
to everyone and a very
happy New Year.



—a greater opportunity for individual initiative and development.
—thru: community living, sharing of fun and responsibility;
health and knowledge and will to preserve it; mastery of
the body, joy and skill in its use, both on land and in
water; keenness of eye and ear; deftness of hand;
senses alert in observations; hearts responsive
to beauty; social consciousness and responsibility;
contentment with simplicity, and
readiness to serve and endure hardship.
"The summer camp restores to
youth much of the naturalness
of living that the modern
community in so many
ways tends to
take away."

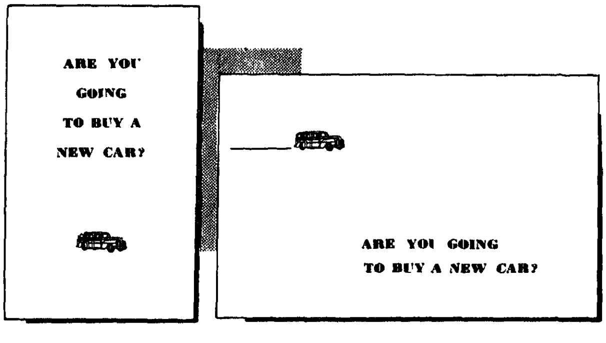
Y.W.C.A.

Formal layouts follow the simple rule of good composition—balance, proportion, contrast, and harmony. They have type set in pyramids, inverted pyramids, rectangular blocks, and fluctuating-line arrangements, as shown in figure 2-6. Formal layouts give the job a pleasingly balanced, though static quality; it is their beauty and symmetry that attracts the eye.

Informal layouts make use of off-centered arrangements, geometric contours, and mixed typefaces. They depend, for interest, on freshness and motion. (See fig. 2-7.)

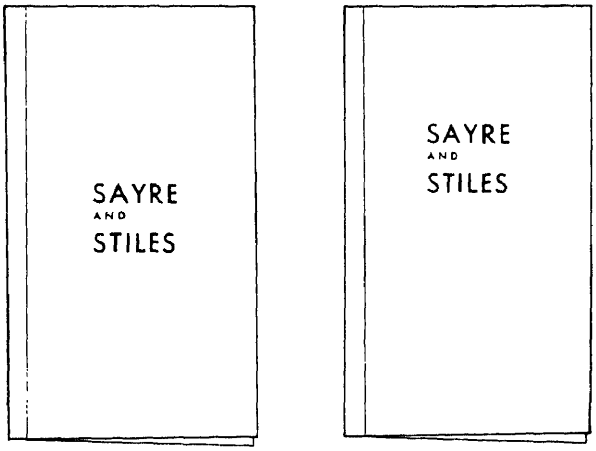
BALANCE.—Balance is a factor in both formal and informal layouts. It is controlled by the size and shape of the elements, their tone (lightness or boldness), and their placement in relation to the optical center of the job. (See fig. 2-8.) The optical center rather than the actual center is used in printing, because the eye normally strikes the page about two-fifths of the way down and slightly to the left of center. Any element placed in the optical center of the page will receive the maximum of attention. It will appear to be pleasingly positioned because it is a bit higher than the actual center. An element placed in the exact center will look as if it were below the center of the page.

Because of this optical quirk, type set in the form of an inverted pyramid is always more pleasing to the eye than is type set in the shape of a pyramid. Refer to figure 2-6. The inverted pyramid places the main body of the form above the center and directs the eye down toward the conclusion of the copy, whereas type set in the pyramid form places the main body of the type at the bottom and carries the eye up and out of the reading matter. Inverted pyramids are a form of centered composition and are used extensively in formal layouts.


ARE YOU GOING TO BUY A NEW CAR?
ARE YOU GOING TO BUY A NEW CAR?

113.12

Figure 2-7.—Comparison of formal and informal layouts.



113.13

Figure 2-8.—Examples of positioning for balance.

Rectangular blocks and fluctuating-line arrangements are also forms of centered composition. Block effects are used in both formal and informal layouts, of course.

Informal layouts have a modern air and make use of off-centered arrangements. The off-centered arrangement gives the job a certain motion and freedom. But in spite of the layout's casual appearance, the elements of the job still must be arranged in an optically balanced order. In planning this type of job, you should try to balance the tones produced by one block of type (or a cut) against those produced by another. You can even balance type and cuts against units of blank space, as shown in figure 2-9. Other than this, there

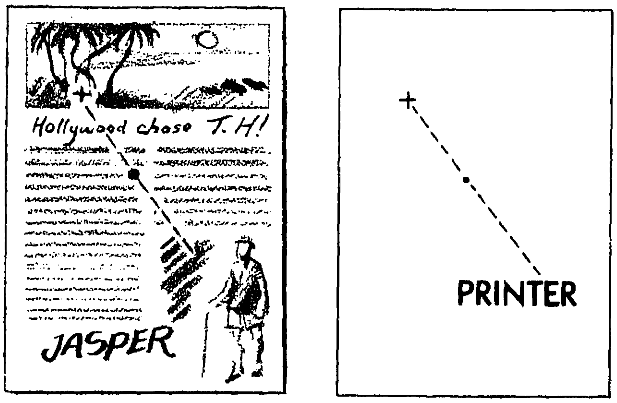


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Figure 2-9.—You can balance type and cuts against one another or against units of blank space.

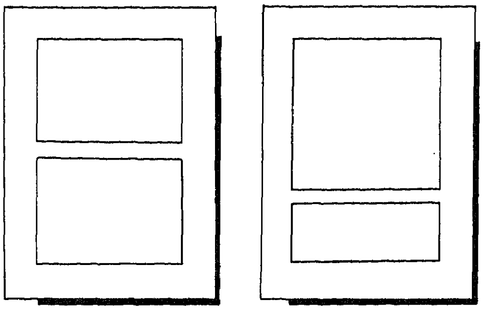
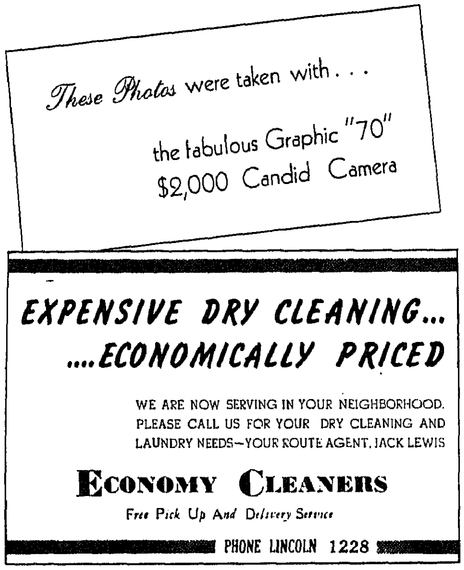


Figure 2-10.—Improved design. 113.15

are no hard-and-fast rules governing off-centered arrangements. The only factor that determines their success or failure is their visual effect.

PROPORTIONS.—Balance alone is not enough. A good printing job, like a new car, must have pleasing proportions to attract and hold the attention of the eye. You have already seen that the proportions (relation of width to depth) of a



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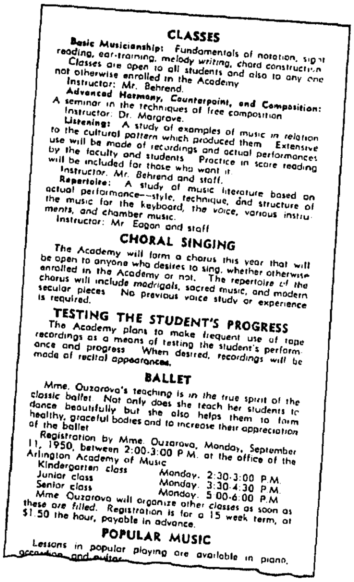

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Instructor: Dr. Margrave.

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The Academy will form a chorus this year that will be open to anyone who desires to sing, whether otherwise enrolled in the Academy or not. The repertoire of the chorus will include madrigals, sacred music, and modern secular pieces No previous voice study or experience is required.

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The Academy plans to make frequent use of tape recordings as a means of testing the student's perform- ance and progress When desired, recordings will be made of recital appearances.

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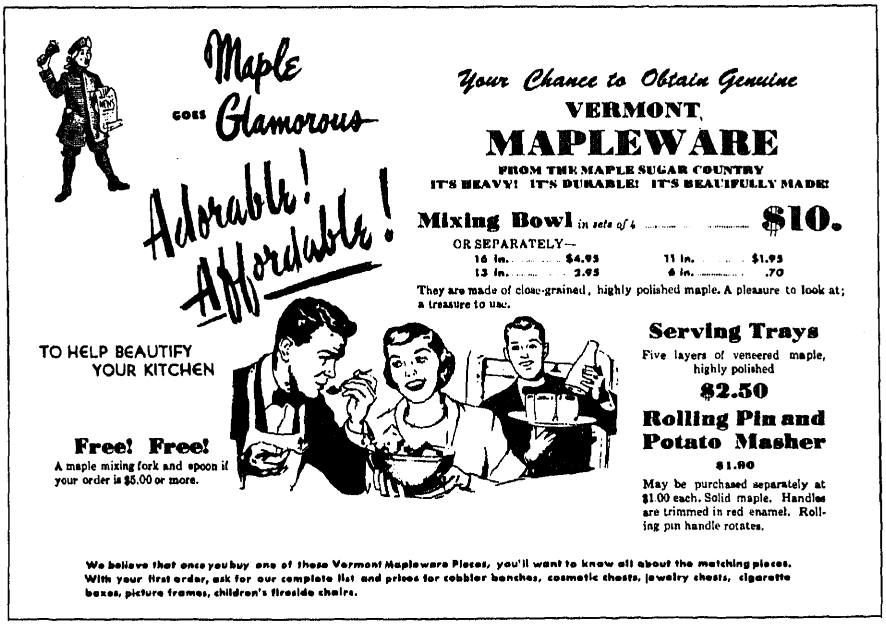

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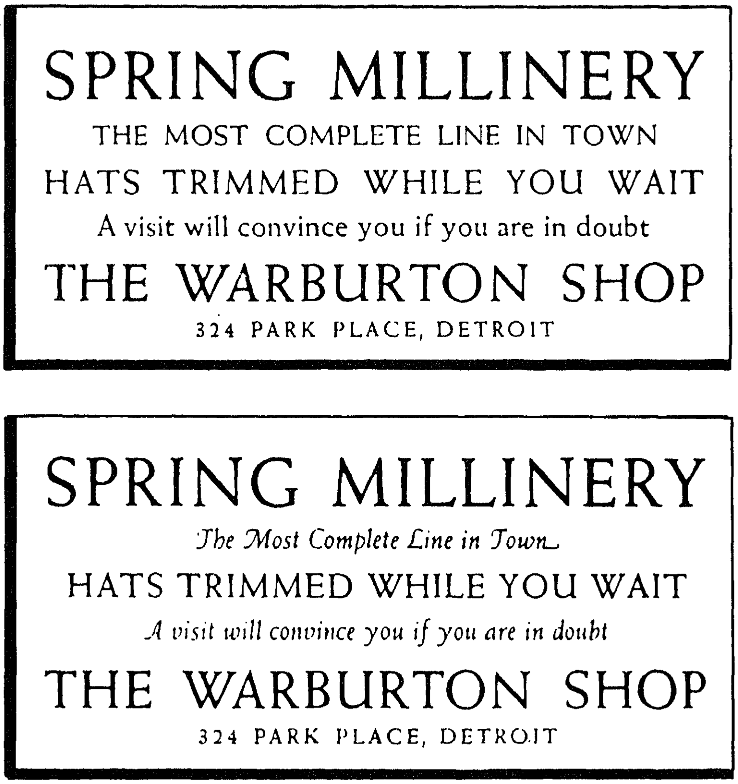

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A visit will convince you if you are in doubt
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Figure 2-12.—If there is little difference in the length of the lines, it will be difficult for the eye to pick out the main items. Notice how contrast in length of lines helps to spotlight the most important items in the lower form.

page are more interesting when the page is laid out in a rectangular form. The various elements of the job, such as blocks of type, cuts, and blank space, should also follow these same general proportions.

Any job will lack interest if its two main elements are equal in size and shape. Such a job not only lacks variety, it also forces the eye to compare the two areas. The example in figure 2-10 shows how the design is improved when one of the elements is made smaller, say two-thirds of its original size.

Similarly, if the layout contains three elements, one element should be large, one small, and one somewhere in between. But none of the elements should be of a size that is a simple multiple of either of the others.

These same principles of proportion apply to the spacing between the border and type and to

CONTRAST.—Contrast is what makes the Sears Tower stand out along the Chicago skyline. And in printing, contrast is the element that makes some of the tones, shapes, and sizes stand out from the others.

You can obtain contrast through the use of large and small typefaces and light and heavy typefaces. (See fig. 2-11.) The use of italics with upright type will also provide a form of contrast, and so will a variety of shapes.

You have already seen how to obtain contrast by grouping related lines into type blocks. Grouping the lines in this manner relieves monotony by setting up a contrast between the type and the blank space.

Variations in contour also add punch to the design. Contrast in the length of lines is almost as important as grouping. If the lines are nearly all the same length, it will be difficult for the eye to pick out the most important elements even though they are set in a bolder type. (See fig. 2-12.) Contrast in shapes and masses not only lends

You can direct the movement of the eye by arranging blocks of type and illustrations. For example, a horizontal block of type will lead the eye sideways from left to right. A vertical (tall, thin) block will lead the eye downward, and so on. Other elements such as arrows, dots, rules, and illustrations also have a strong drawing power on the eye. Therefore, these elements should be positioned to lead the eye into the design and not out of it. This means that the tip of an arrow should be pointing into the type and that cuts of people or animals should be positioned with the object facing into the design.

HARMONY.—Harmony of shapes, tones, colors, and type styles in layout is just as important as harmony is in music. In printing, if every heading is set in a different style of type and if every element has its own unique style and shape, the results are certain to be displeasing.

You have already seen that the proportions of the blocks of type should harmonize with the proportions of the page. But harmony goes further than that. It also enters into the choice of typefaces, cuts, and borders. In selecting a typeface, you should try to pick one that will match the subject matter of your copy. The typeface should go well with the text and match the weight of the lines in the illustrations.

Always choose borders that follow the tone values of the type and illustrations. Don't use a heavy border with a light typeface, and vice versa. Certain borders are designed to go with certain styles of type, and the results will be better if you try to match border to type style. (See fig. 2-13.)

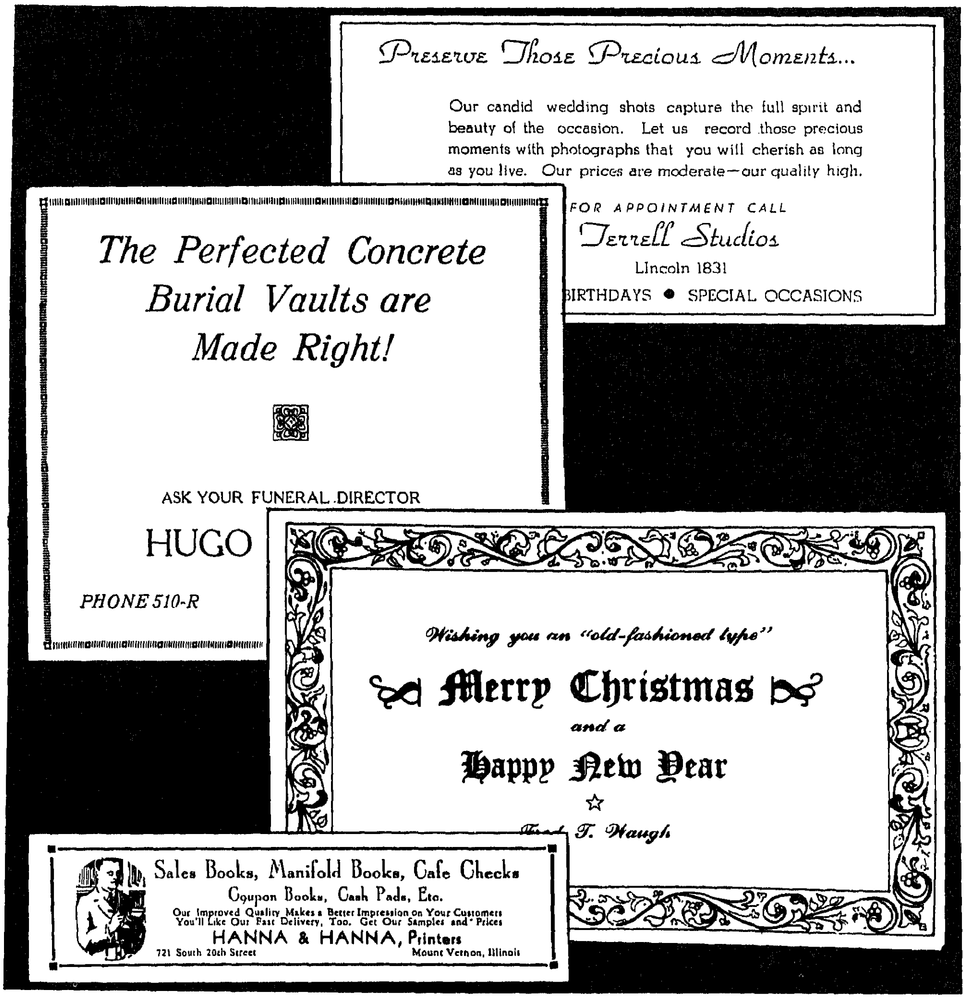

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Figure 2-13.—Type, borders, and illustrations should match in tone value and style.

Of course, it isn't necessary that you make an actual layout for each job that comes into the shop. But there may be times when you will want to prepare a layout for the guidance of your personnel or to give the person ordering the printing an idea of what the finished job will look like. In such instances, layouts save both time and effort because they enable everyone to visualize the completed job and to shift emphasis or settle controversial points before the work is composed.

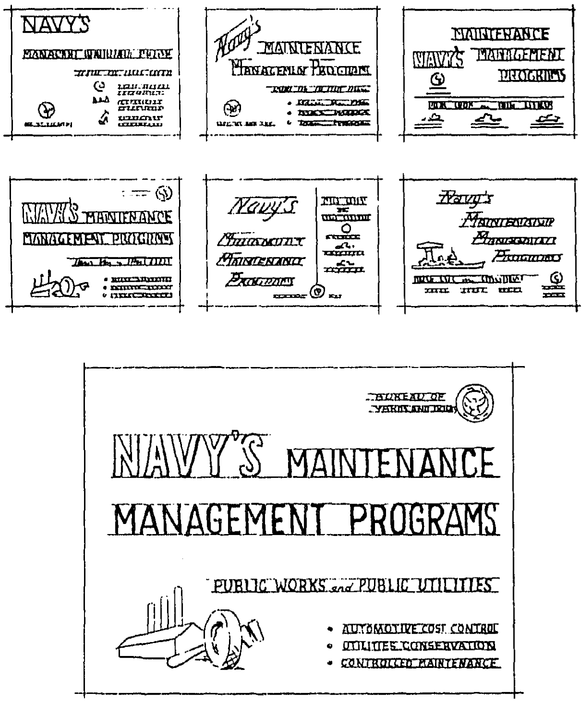
Your layouts will not require finished illustrations or lettering. However, they require that you have a thorough knowledge of the principles of good design. When it becomes necessary to use finished illustrations or lettering in the layout, you can trace them or ask a draftsman to handle them.

Layouts can be made on any kind of paper, but often they are made on sheets of graph paper or on tracing paper. Tracing paper is especially suitable because it is sufficiently translucent to enable you to trace type and illustrations. It also permits you to shift the various elements of the job. If your original layout isn't satisfactory, you can place a clean sheet of tracing paper over it and trace off the elements, shifting the paper to change the location of the units as you see fit.

You can start by making a number of experimental sketches, like those shown in figure 2-14. Keep them simple; draw them small with a minimum of detail. Try various combinations until you hit on a design you like. When you find such a design, draw it to the exact size required and place the elements in the proper positions, as also shown in figure 2-14.

When possible, sketch or trace illustrations in the proper positions on the layout. If you are pressed for time, you may simply rule in an accurate outline of the cut or if a proof is available, you can clip it and paste it in place in the layout. You may fill in dark areas with pencil to show the tone of the illustrations as compared to that of the type.

When doing a layout, most personnel letter in headings and display lines and indicate blocks of small type with ruled lines, as shown in figure 2-15. You should confine the small lines to the exact area that will be required for the type. Indicate where the copy is to go by writing the same letter on both the typed manuscript and the layout, as also shown in figure 2-15. In lettering



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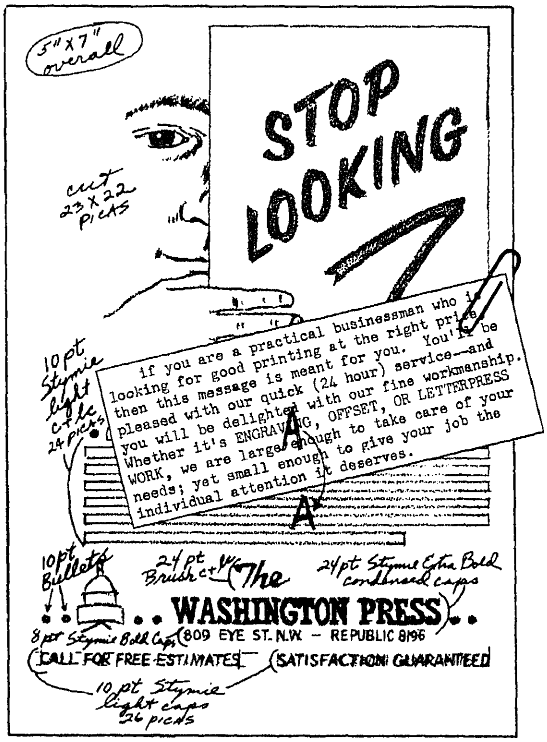

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113.19

display lines, you should trace letters from a type specimen sheet, as this will ensure that the lettering will fit the space allotted when the composition is completed. When you cannot trace the letters, you may simply rough in the display lines, using letters whose size and weight correspond to the typeface to be used.

If you are going to use borders, be sure to indicate the kind desired. It is sufficient to rule a straight line around the layout itself, but the width of the line should be such that it will show the approximate weight of the border selected. If the border is complicated or unusual, you may paste a sample of it on the layout.

When the layout has been arranged satisfactorily, you should write instructions to indicate

- the kind of type to be used;
- the dimensions of the type areas; (Mark the exact dimensions of the type form. You should always give the width first. If the copy is 24 picas wide and 40 picas deep, you should mark it 24 x 40 picas.)
- the amount of space used between the lines;
- the amount of space provided between words, letters, and margins, if exact spacing is desired; and
- where each cut should go by writing the same number or letter on both the copy and in its position on the layout.

After you have finished your layout, you should place it in the work jacket for the job. The copy preparation department will use the layout in preparing cold type composition and pasting up the work for the cameras. The stripper also might use the layout for reference in stripping in inserts and halftones.

Figure 2-16 shows the finished job from the rough display layout in figure 2-15. Figure 2-17 is another example of a display layout and the finished printed product.

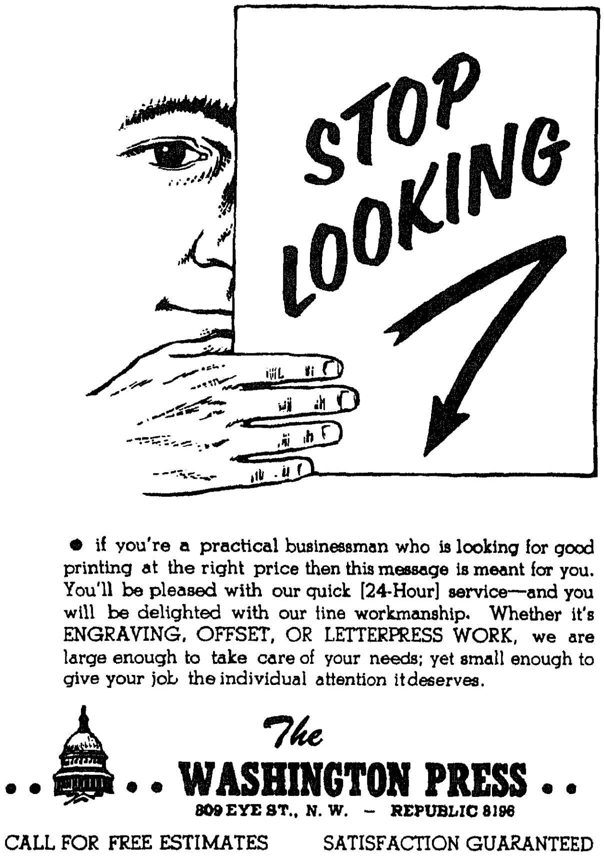

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Figure 2-16.—The job set from the display layout shown in figure 2-15.

LAYOUTS FOR BOOKS AND PAMPHLETS

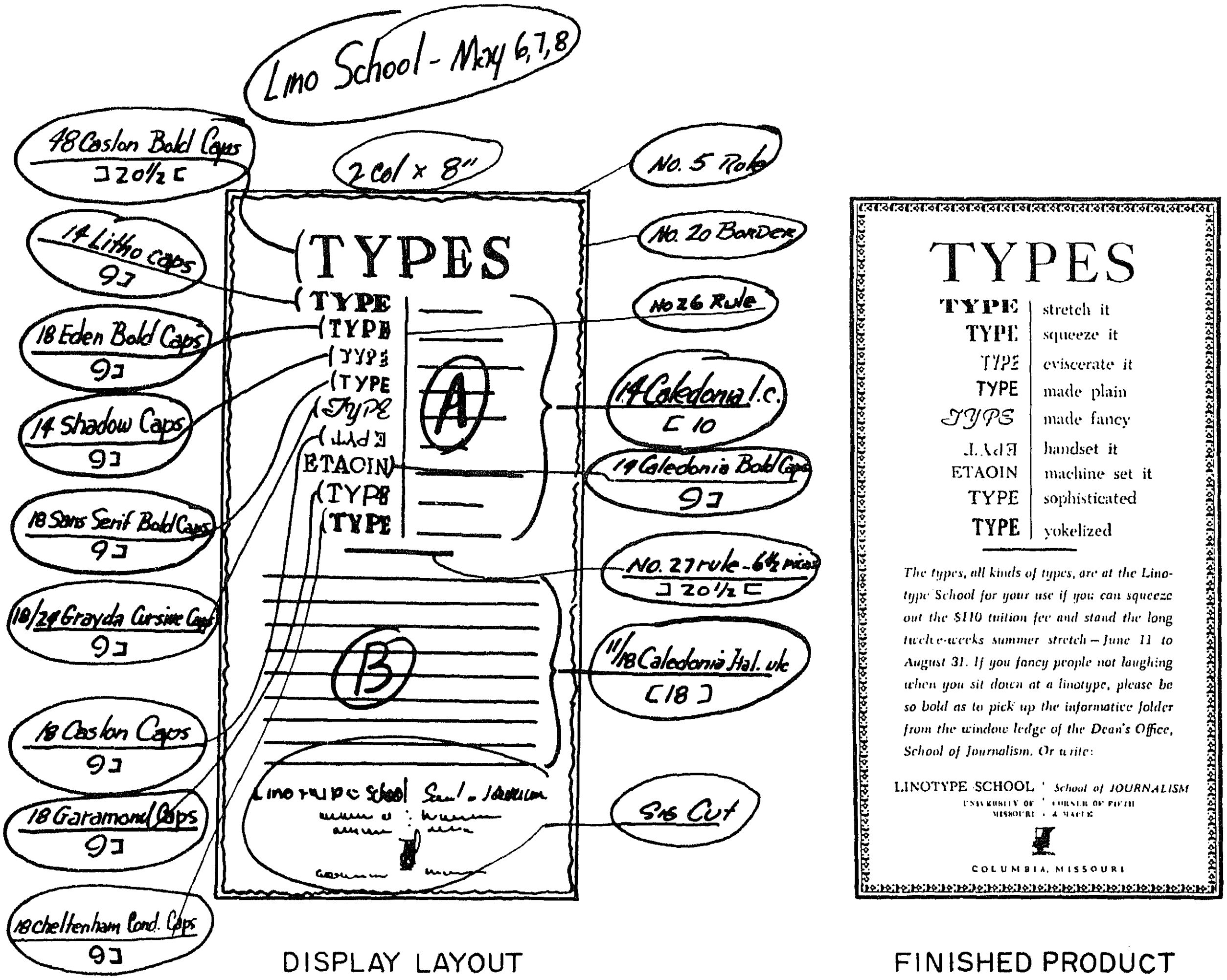
In a small shop, you might not have the opportunity to make a layout for a booklet or pamphlet. But in a large shop, you might be called on to do all types of work, so you should know how such layouts are prepared.

Layouts for booklets and pamphlets are usually called dummies. There are two types of dummies:

Preliminary—those made up before the type is set, and

Paste-Up—those made from proofs after the composition is complete.

These dummies will be discussed in detail later in this chapter.



DISPLAY LAYOUT

TYPES

TYPE	stretch it
TYPE	squeeze it
TYPE	eviscerate it
TYPE	made plain
TYPE	made fancy
TYPE	handset it
ETAOIN	machine set it
TYPE	sophisticated
TYPE	yokelized

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FINISHED PRODUCT

113.21X

Figure 2-17.—A display layout marked for the printer and the finished product.

If the copy is rather long, determining how many pages it will fill when it is typed can be difficult. So, to guide the compositor, you may simply make layouts for key pages, such as the title page and one or two of the text pages. Leave the actual page-by-page layout until you get the originals from the compositors. Then you can use the originals to make a paste-up dummy showing the actual locations of the type and illustrations on each page of the book.

Of course, if the copy is short, you might be able to "copyfit" it to determine in advance the number of pages it will fill. You can then make a preliminary dummy for each page. Depending on the size of the job, the lithographer may need to prepare preliminary and paste-up dummies and press layout sheets. (See fig. 2-18.) The press layout sheets are used when printing the job. They are folded just as the finished sheets would be in the bindery after printing. The pages are numbered in their proper sequence to show the arrangement of the pages. The press layout sheets sometimes show the location of the printed matter and provide other information, such as margins, cut marks, backups, and signature marks.

There are several methods of copyfitting. The words-per-square-inch method is rather inaccurate and should only be used for rough calculations. For accurate calculations, you should use the character-count method. This method is based on the number of typewritten characters in the manuscript.

When exact copy-figuring is not required, the words-per-square-inch method will do

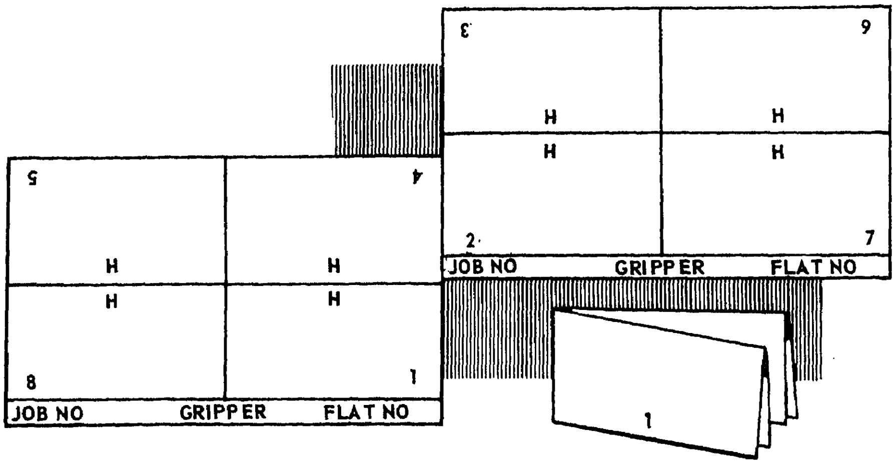

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Figure 2-18.—Press layout sheet.

very well. Table 2-1 shows the approximate number of words per square inch for different sizes of type.

When used with table 2-1, the example below will help to make the words-per-square-inch method of copyfitting clearer.

> Example: Suppose you have 750 words of copy to be composed in 10 point, solid. Table 2-1 shows 21 words per square inch for 10 pt., solid type. If you divide the 750 by 21, you will find that the copy will require approximately 36 square inches of space. You can compose it 4 by 9 inches, 3 by 12 inches, or in any other combination of width and depth that will make up the 36 square inches.

You can also use this table to find the number of words that will fit into a given space. Suppose you have a space 24 picas (4 inches) wide and 8 inches deep to be filled with 10-point type with 2-point spacing between lines.

Also in table 2-1, you will see that there are approximately 16 words to the square inch when the copy is composed 10-point leaded. Your space is 4 inches wide and 8 inches deep, which is a total of 32 square inches. Multiplying 32 by 16 gives you 512 as the approximate number of words that will fit into the space. Actually, you could get closer to 530 words in this amount of space. REMEMBER: The words-per-square-inch method of copy-figuring does NOT give you a completely accurate number.

To use the character-count method for determining the amount of space the typewritten material will fill, you must determine the number of typewritten characters (and spaces) contained in the manuscript. In addition, you must also know the number of characters (and spaces) that will go into a line set to the proper width for the size and style of type desired for the finished manuscript and the number of lines of that size type that will fill a column inch.

1. Find the number of characters (and spaces) on each page of the typed manuscript, using the method described below:

> Draw a pencil line down the right side at the point where the majority of the lines end. Then count the number of characters and spaces that occur in the top line between the left margin and the pencil line. Multiply this by the number of lines on the page. To this total, add the number of characters that extend beyond the pencil line, and subtract the number of spaces that any line is short of the pencil line. After you have found the number of characters (and spaces) on each page, add them all together to get the total number of characters in the manuscript.

Table 2-1.—Example of Computing Words Per Square Inch

Size of type	Words per square inch	Size of type	Words per square inch
6 pt., solid	47	12 pt., solid	14
6 pt., 2 pt. leaded	34	12 pt., 2 pt. leaded	11
8 pt., solid	32	14 pt., solid	11
8 pt., 2 pt. leaded	23	14 pt., 2 pt. leaded	7
10 pt., solid	21	18 pt., solid	7
10 pt., 2 pt. leaded	16	18 pt., 2 pt. leaded	5

2. Next determine the number of characters that will go in one line set to the proper width in a suitable typeface.

   a. Find a printed specimen composed in the size and type style that you wish to use.
   b. On this specimen measure off the width you wish to use and draw a line down the right side.
   c. Count the characters (and spaces) in five representative lines to see how many characters occur between the left margin and the pencil line on the right.
   d. Divide the total number of characters found in the five lines by 5 (the number of lines counted). This will give you the average number of characters per line for this style and size of type.
   e. Divide the total number of characters in the manuscript by the average number of characters that will go into one line of type. The result will be the number of lines that the copy will fill.

3. Now, determine how many lines (of the selected size type and spacing) will go in 1 inch. Divide the total number of lines by that number to find the length of the copy in inches.
4. Finally, make allowance for headings and illustrations in determining the total amount of space that your copy will fill.

If you find that the copy will not fit into the amount of space allotted to it, you may select a smaller typeface, vary your spacing, or have the copy reduced.

You can vary the process just described by measuring the typewritten copy with a ruler. (The standard "elite" typewriter has a 10-point face and types 12 characters to the inch; the standard "pica" typewriter has a 12-point face and types 10 characters to the inch.) Measure off a distance from the left margin of your copy and draw a line down the right side. Ensure that the line touches the end of most other lines in the copy.

If your typewriter types 10 characters to the inch, and if your pencil line is 5 inches from the left margin of the copy, your average line will contain 50 characters.

To find the number of lines per page, measure the depth of the copy. If the copy is single spaced, there will be six lines to the inch; if it is double spaced, there will be three lines to the inch. Thus, if your copy is double spaced and is 7 inches from top to bottom, you will have 21 lines on the page.

To find the number of characters on the page, multiply the number of lines by the number of characters per line.

$$\begin{array}{rl} 21 & \text{(lines)} \\ \times\ 50 & \text{(characters)} \\ \hline 1{,}050 & \text{(characters)} \end{array}$$

But you aren't through yet!

You must add to this the number of characters and spaces that the long lines run beyond the pencil line, and you must subtract from the total the number of spaces that are required to fill out the short lines. When this has been done, you will have the total character count for the page.

By reversing the procedures just described, you can determine the amount of copy that will be needed to fill a given space.

1. Determine the number of characters that will fit into the average line set to the proper width in the desired size and style of type.

2. Determine how many lines of the desired size type and leading will be required to fill the space.

3. Set the marginal stops on your typewriter so that each typewritten line will contain the same number of typewritten characters as the average typeset line (step 1). The typewritten copy will then agree almost line for line with the typeset material, and you can simply type enough copy to fill the number of lines arrived at in step 2.

PRELIMINARY DUMMIES

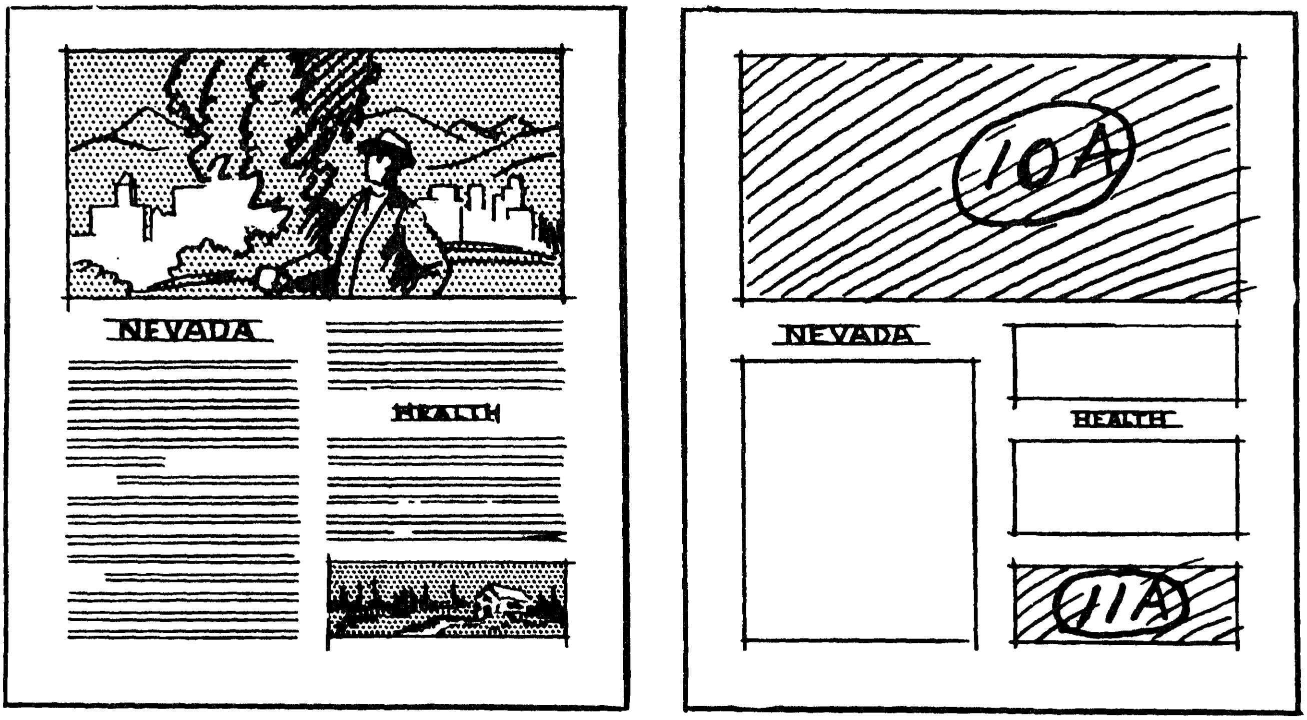
In making a preliminary dummy, you may begin with any page of the text, but you should follow the *same* pattern or theme on the other pages.

First make a series of thumbnail sketches, building your design around the most important elements on the page just as you would in making a rough layout. Choose the best of your thumbnail sketches and draw it up to full size. Then work the full-sized rough layout into a finished layout.

In working with text pages, you may indicate type areas either by ruling in a rectangle on the page or by ruling in a series of lines. (See fig. 2-19.) Trace or rough in the principal display lines, and sketch or trace the illustrations, or rule in an outline and indicate the photograph or illustration that is to go there.

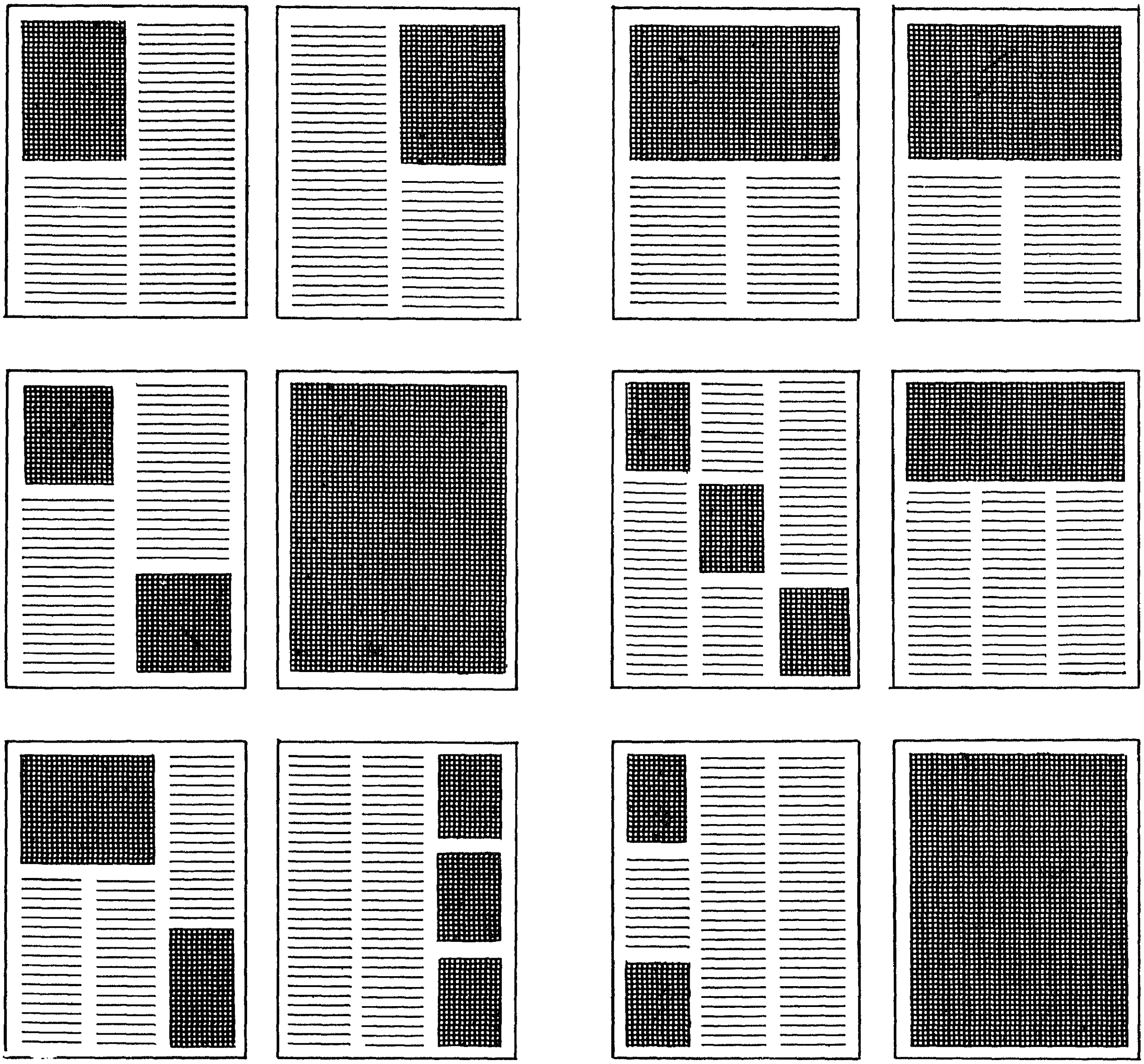
Illustrations should be placed close to the section of the text to which they apply. Single illustrations are usually placed at the top of the page or just above the optical center of the page. If an illustration is narrower than the type or if it does not have a square outline, you should run four or five lines of type above and below it to square up the page. If the illustration is extremely narrow, you may have the type set on a narrow measure and placed in the column beside it.

In display artwork you are generally dealing with a single page, but in bookwork, you must consider the two facing pages as the unit in planning your design. (See fig. 2-20.) Most layout personnel will agree that the right page should outweigh the left. So when you have only one cut, you should place it on the right page. If you have two large rectangular illustrations, you should use one at the top of each of the two facing pages.



113.22

Figure 2-19.—Methods of indicating type and illustrations on the layout sheet.



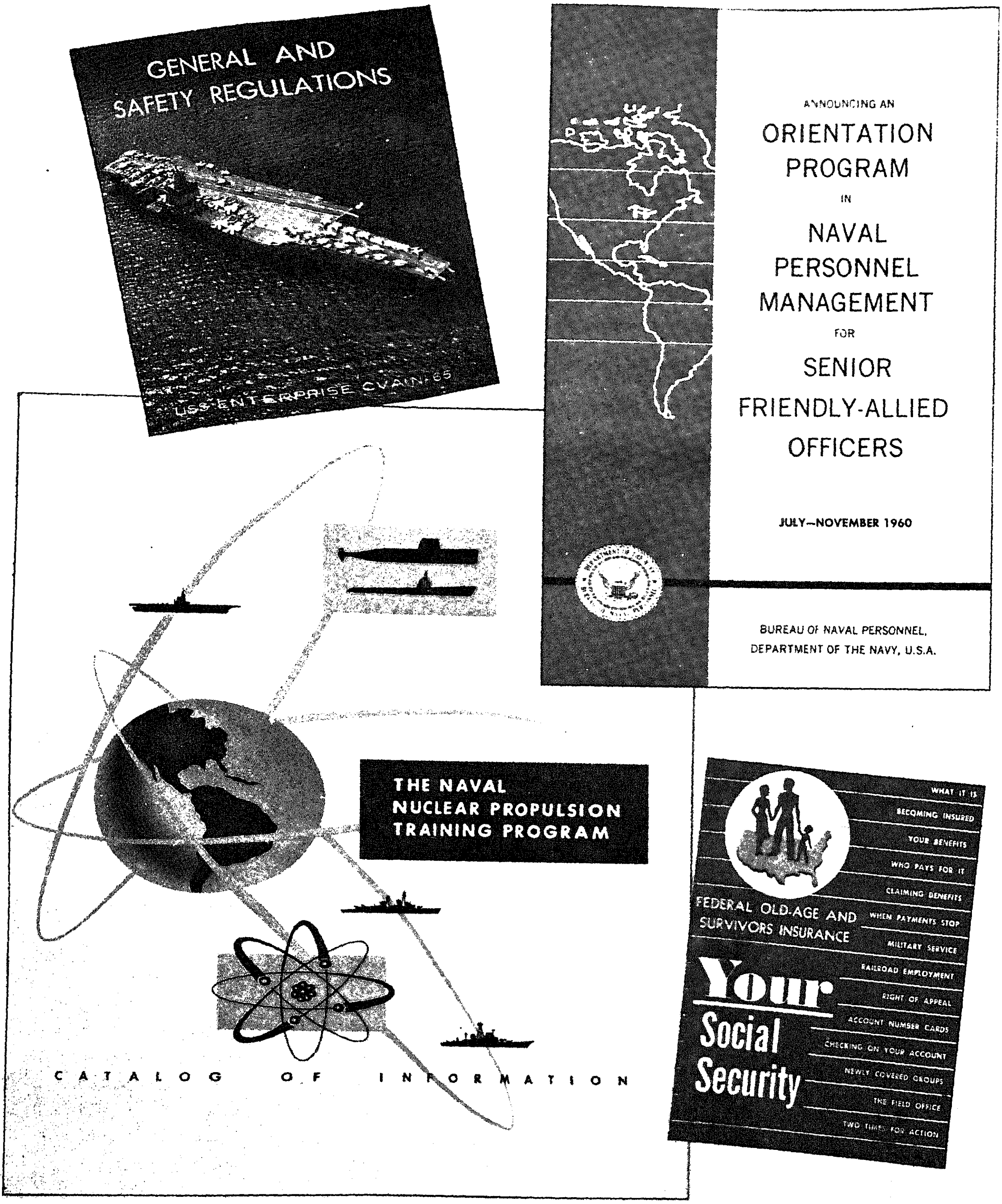
149.47

Figure 2-20.—How to position illustrations on facing pages. The right page generally predominates the left.

Always leave plenty of blank space for margins around the type. Narrow margins cause the page to look crowded and make it difficult to read. If you are dealing with a single page, the right and left margins should be even, but the bottom margin should be slightly larger than the top. This relieves the monotony created by even margins.

In bookwork, the back or inner margin of the page is often made narrower than the other margins so that when the book is opened, the gutter of white space down the center will appear to be equal to the width of either of the outside margins. The top margin is slightly larger than the back margin; the outside margin is larger still; and the bottom margin is the largest of the group.

Bleed illustrations add interest to a page; however, they increase the difficulty in planning and they could be costly. Therefore, you should not bleed all the illustrations in a book. If you have several small illustrations,



GENERAL AND
SAFETY REGULATIONS

USS ENTERPRISE CVA(N)-65

ANNOUNCING AN
ORIENTATION
PROGRAM
IN
NAVAL
PERSONNEL
MANAGEMENT
FOR
SENIOR
FRIENDLY-ALLIED
OFFICERS

JULY—NOVEMBER 1960

BUREAU OF NAVAL PERSONNEL,
DEPARTMENT OF THE NAVY, U.S.A.

THE NAVAL
NUCLEAR PROPULSION
TRAINING PROGRAM

CATALOG OF INFORMATION

FEDERAL OLD-AGE AND
SURVIVORS INSURANCE

Your
Social
Security

WHAT IT IS
BECOMING INSURED
YOUR BENEFITS
WHO PAYS FOR IT
CLAIMING BENEFITS
WHEN PAYMENTS STOP
MILITARY SERVICE
RAILROAD EMPLOYMENT
RIGHT OF APPEAL
ACCOUNT NUMBER CARDS
CHECKING ON YOUR ACCOUNT
NEWLY COVERED GROUPS
THE FIELD OFFICE
TWO TIMES FOR ACTION

113.23

Figure 2-21.—Interesting cover designs.

you may group them in a panel and let the panel bleed.

The cut lines or legends below the illustrations are normally composed full-column width regardless of the width of the cut. If the legend consists of only one or two lines, you should center it; otherwise compose the first line flush (even) with the left margin and indent the lines that follow. This style is referred to as a hanging indention.

Cover Design

The cover design may consist of illustrations and type, hand lettering and type, or type alone. (See fig. 2-21.) If the publication is one of a series, the cover should match the others in the series. It may be run on a different color of stock, but it should have the same general characteristics as the covers of other publications in the series.

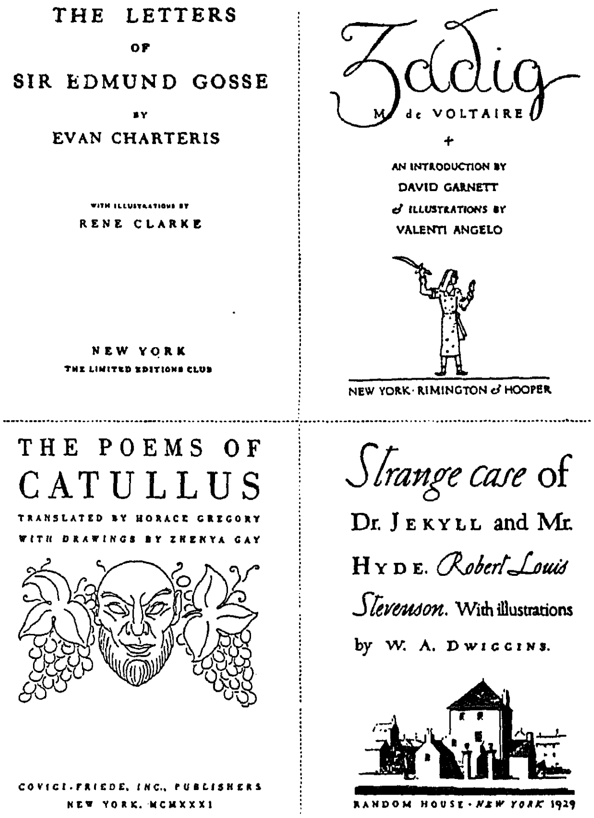
If the type is well arranged and of a size sufficient to give the display required, you can use almost any typeface on the cover. The choice is sometimes affected, of course, by the historical period or the mood of the text.

When possible, titles should be limited to five or six words of copy because long titles on the cover look awkward when they are composed in large type.

Title Page

The type used for the title page (see fig. 2-22) is usually from the same series (different sizes of the same typeface) or family (similar typefaces in design) as that used for the text unless a different typeface is required for distinctiveness.

The type generally follows the inverted pyramid, block, or fluctuating-line arrangements, although off-centered arrangements may be used for some types of work. Compose the title in the largest size of type and display the other lines according to their importance. The dimensions of the title page are usually the same as those of the regular text page.



THE LETTERS
OF
SIR EDMUND GOSSE
BY
EVAN CHARTERIS

WITH ILLUSTRATIONS BY
RENE CLARKE

NEW YORK
THE LIMITED EDITIONS CLUB

Zadig
M de VOLTAIRE
+
AN INTRODUCTION BY
DAVID GARNETT
& ILLUSTRATIONS BY
VALENTI ANGELO

NEW YORK · RIMINGTON & HOOPER

THE POEMS OF
CATULLUS
TRANSLATED BY HORACE GREGORY
WITH DRAWINGS BY ZHENYA GAY

COVICI-FRIEDE, INC., PUBLISHERS
NEW YORK. MCMXXXI

Strange case of
Dr. JEKYLL and Mr.
HYDE. *Robert Louis*
Stevenson. With illustrations
by W. A. DWIGGINS.

RANDOM HOUSE · *NEW YORK* 1929

113.24X

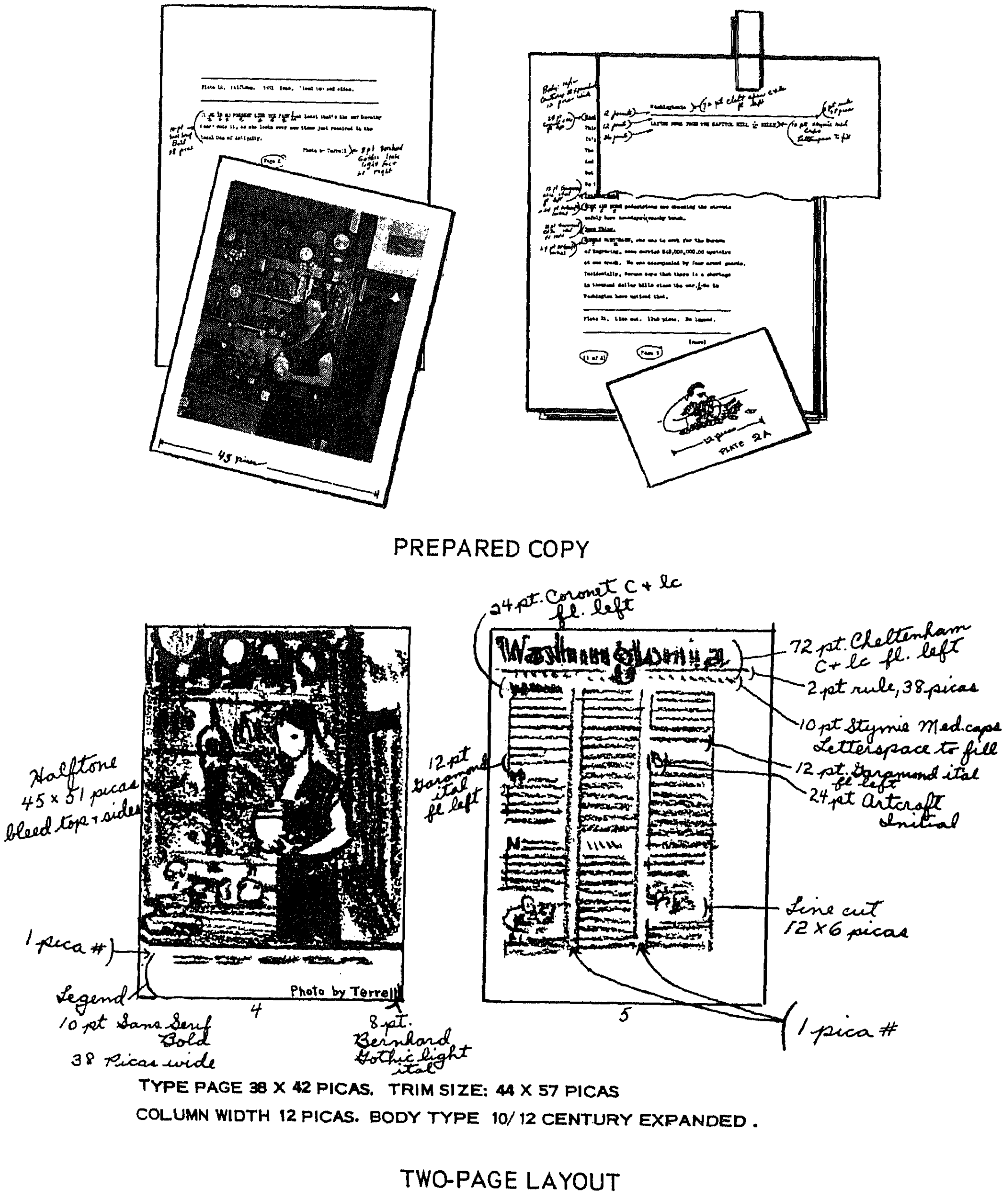
Figure 2-22.—Title page designs.

Other Pages

The principal requirements for all the other pages, such as the preface or contents, are that they be legible and attractive.

In planning an index, you should place convenience to the reader ahead of artistic design. These pages generally call for short lines, composed in 8-point type, with hanging indentions, and initials or words composed in caps or boldface type. The page is often divided into two or three columns.

After you have laid out all the pages, you should mark up the job, writing printer's instructions on both the manuscript copy and the layout sheets. Figures 2-23 and 2-24 show two ways to mark the layout and manuscript, and figure 2-25 shows proofs of pages made up according to these instructions.


45 picas
PLATE 2A
24 pt. Coronet C + lc fl. left
72 pt. Cheltenham C + lc fl. left
2 pt rule, 38 picas
10 pt Stymie Med. caps Letterspace to fill
12 pt. Garamond ital fl left
24 pt Artcraft Initial
12 pt Garamond ital fl left
Halftone 45 x 51 picas bleed top + sides
1 pica #
Photo by Terrell
Legend 10 pt Sans Serif Bold 38 Picas wide
4
8 pt. Bernhard Gothic light ital
5
Line cut 12 x 6 picas
1 pica #

PREPARED COPY

TYPE PAGE 38 X 42 PICAS. TRIM SIZE: 44 X 57 PICAS
COLUMN WIDTH 12 PICAS. BODY TYPE 10/12 CENTURY EXPANDED.

TWO-PAGE LAYOUT

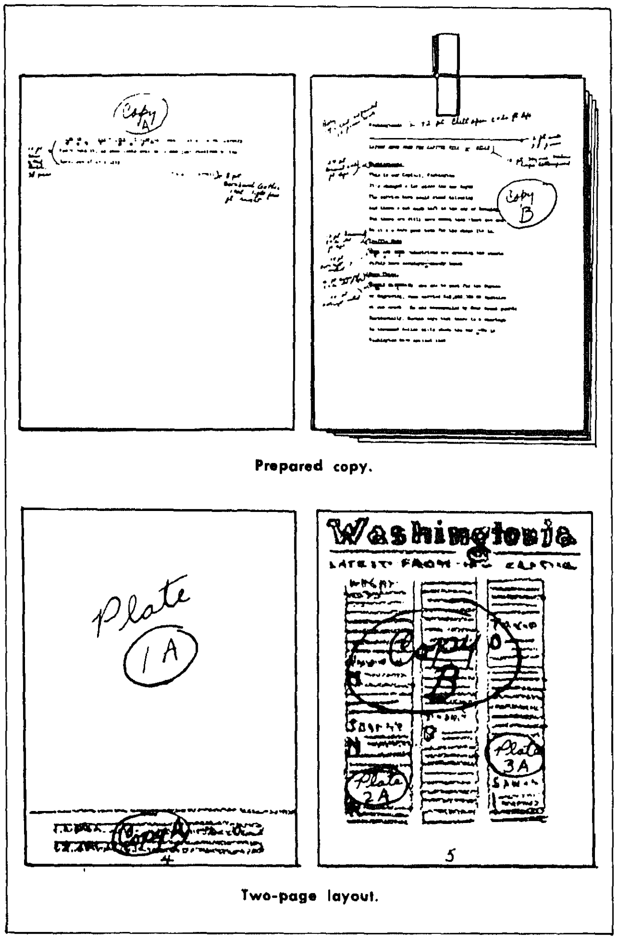
149.50.1

Figure 2-23.—One method of indicating areas for illustrations and type.

PASTE-UP DUMMIES

If the copy is so long that you cannot accurately determine the number of pages it will fill, you should prepare layouts for key pages (to set the style for the publication) and leave the actual page-by-page layout until the type has been set. You can then trim the typed originals and paste them in place on the layout sheets, along with proofs of the illustrations.

Printed layout sheets showing the outline of the page and an outline for the type area are generally used for paste-up dummying. The printed layout sheets may consist of single pages, as shown in figure 2-26, or they may be printed two up, since facing pages are used as the unit in layout work. If single sheets are used, the facing pages should be placed side by side when they are laid out and pasted. In all cases, you should use only one side of the sheet.



Prepared copy.

Two-page layout.

149.50.2

Figure 2-24.—Another method of indicating areas for illustrations and type.

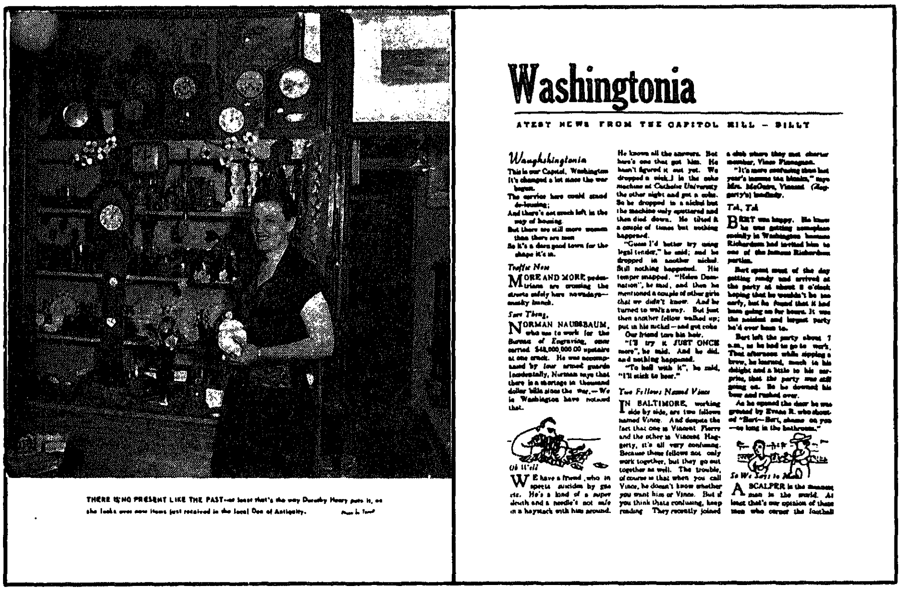
Before starting the paste-up, you should number each composed page, as shown in figure 2-27. Use a heavy lead or grease pencil and make the numbers conspicuous so the type is clearly identified when the page is composed. You can then trim your composed pages and begin the paste-up. Some layout personnel use rubber cement to mount pages on the layout sheets. Others use strips of Scotch tape, since the Scotch tape makes it easier to shift the proofs if changes are to be made. However, today most layout work is accomplished with the aid of a waxing machine vice rubber cement or tape.

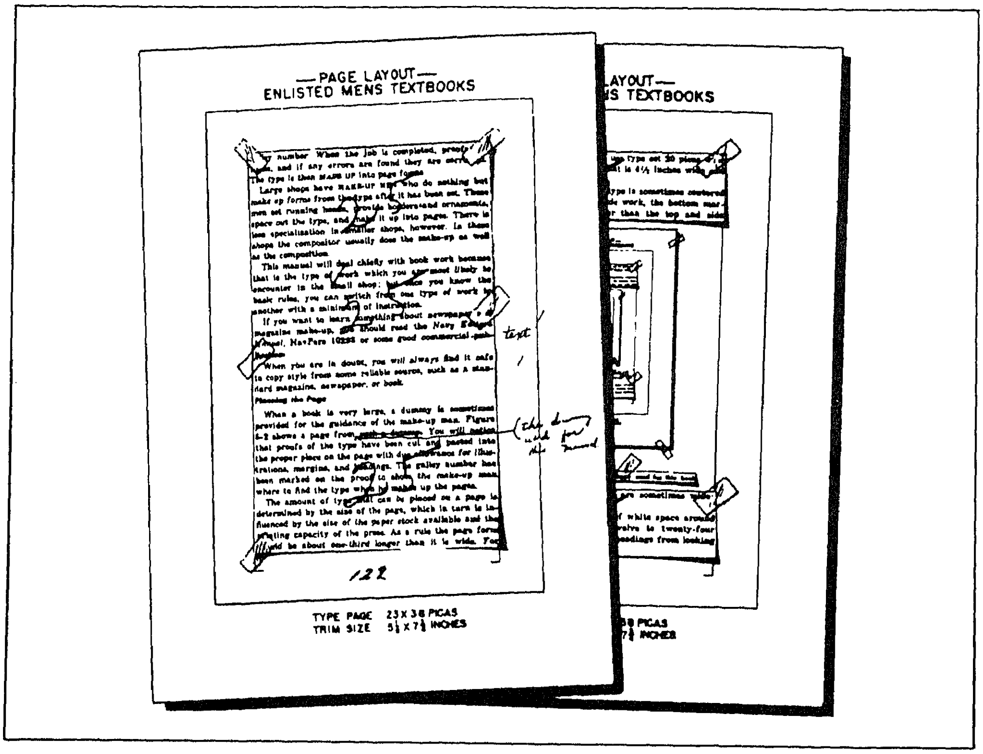
NOTE

Unfortunately type doesn't always measure out the way you would like it. And you may find yourself with too little or too much space. Therefore, it is a good idea to keep several pages laid out in advance so you can see how the copy and illustrations fit the space before you begin pasting them in place.

PASTE-UP DUMMIES FOR MAGAZINES AND NEWSPAPERS

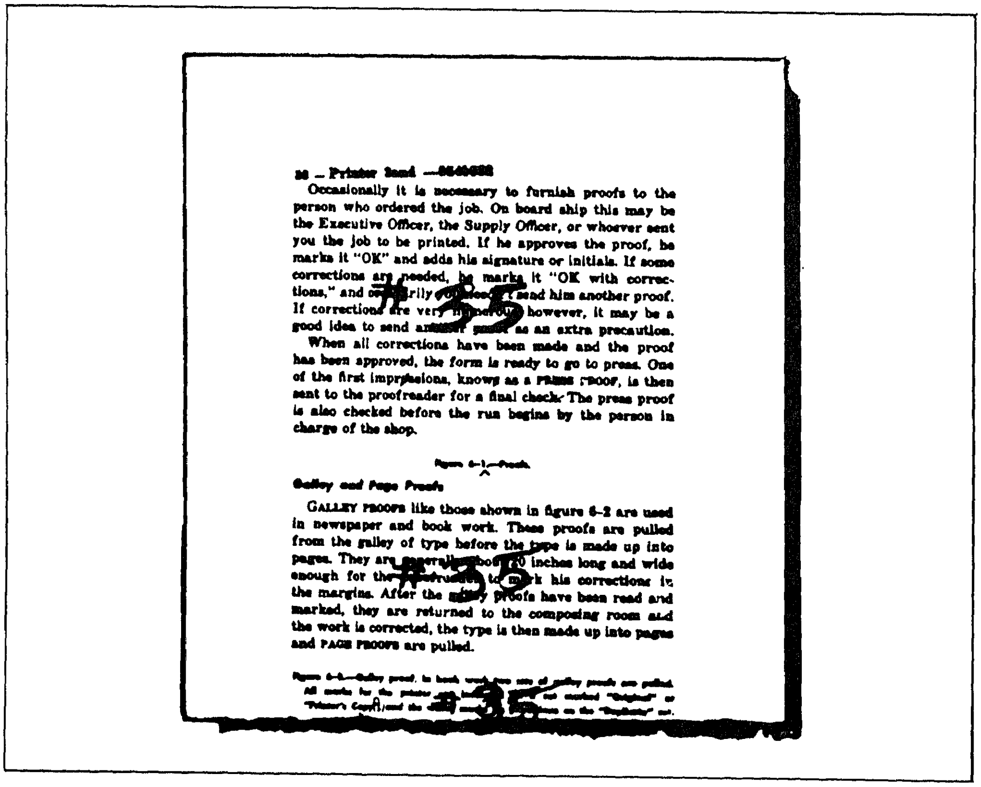
Paste-up dummies, like those just described, are frequently used in magazine and newspaper





113.25

Figure 2-26.—Pages from a paste-up dummy.



[illegible] — Printer [illegible] —[illegible]

Occasionally it is necessary to furnish proofs to the person who ordered the job. On board ship this may be the Executive Officer, the Supply Officer, or whoever sent you the job to be printed. If he approves the proof, he marks it "OK" and adds his signature or initials. If some corrections are needed, he marks it "OK with corrections," and o[illegible]rily [illegible] send him another proof. If corrections are very numerous, however, it may be a good idea to send another proof as an extra precaution.

#35

When all corrections have been made and the proof has been approved, the *form* is ready to go to press. One of the first impressions, known as a PRESS PROOF, is then sent to the proofreader for a final check. The press proof is also checked before the run begins by the person in charge of the shop.

Figure 6-1.—Proofs.

Galley and Page Proofs

GALLEY PROOFS like those shown in figure 6-2 are used in newspaper and book work. These proofs are pulled from the galley of type before the type is made up into pages. They are generally about 20 inches long and wide enough for the proofreader to mark his corrections in the margins. After the galley proofs have been read and marked, they are returned to the composing room and the work is corrected, the type is then made up into pages and PAGE PROOFS are pulled.

#35

Figure 6-2.—Galley proof. In book work two sets of galley proofs are pulled. All marks for the printer [illegible] marked "Original" or "Printer's Copy," and the [illegible] on the "Duplicate" set.

#35

113.26

Figure 2-27.—Numbering of pages for composition.

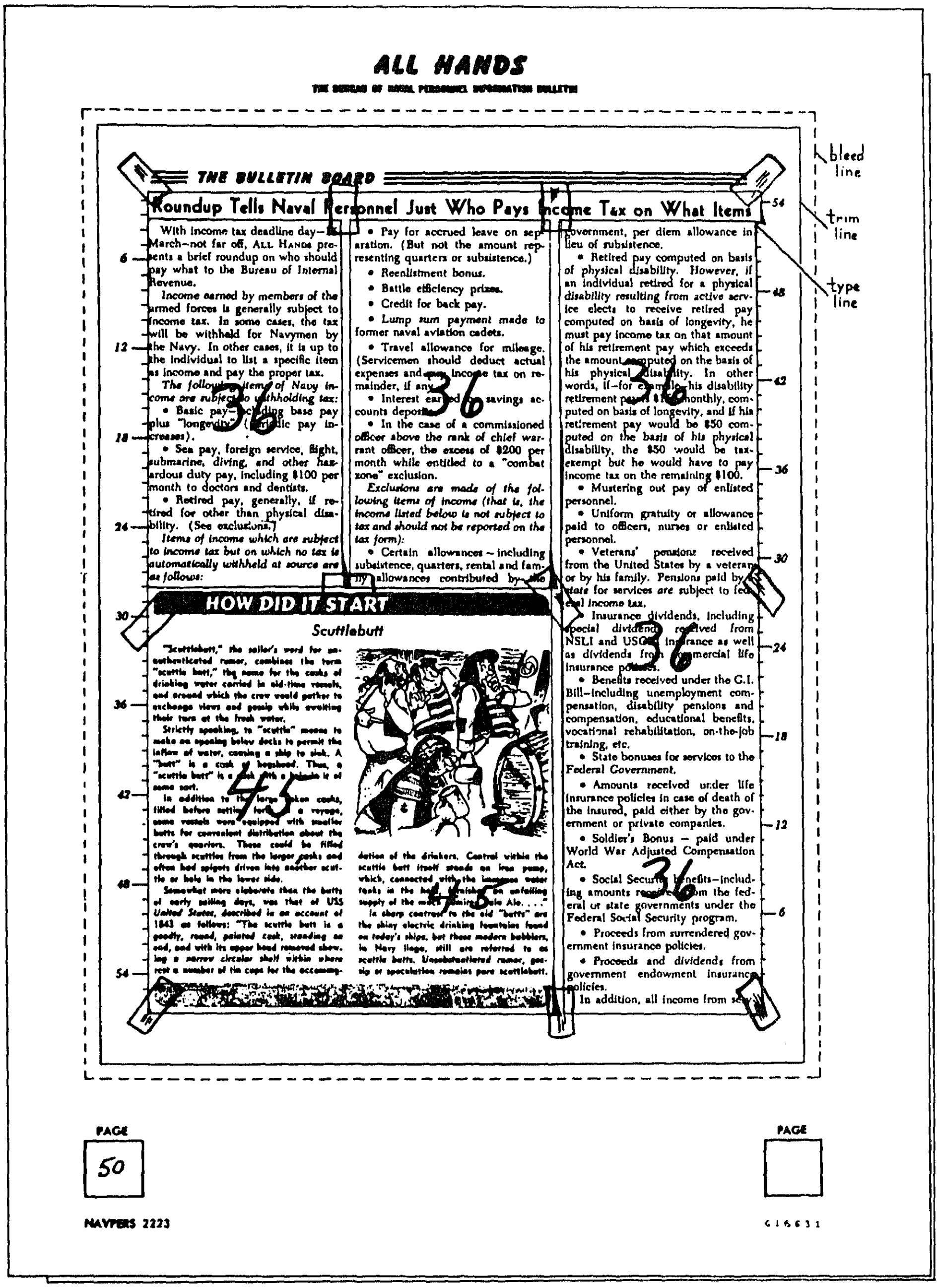
work. Figure 2-28 shows a paste-up dummy used for *All Hands* magazine; and figure 2-29 shows how the paste-up is used in the production of a Navy newspaper.

MARKING THE LAYOUT SHEETS

Spacing instructions and other information, such as folio (page) numbers and running heads, are always written on the layout sheet. The size of the type page, the trim size of the page, and the column widths are also indicated on the layout sheet.

MARKING MANUSCRIPT COPY FOR THE PRINTER

When a word is underlined, the printer knows to set the word in italics. Figure 2-30


ALL HANDS
THE BUREAU OF NAVAL PERSONNEL INFORMATION BULLETIN
bleed line
trim line
type line
6
12
18
24
30
36
42
48
54
36
36
36
36
45
45
PAGE
50
PAGE
NAVPERS 2223
616631

THE BULLETIN BOARD

Roundup Tells Naval Personnel Just Who Pays Income Tax on What Items

With income tax deadline day—[illegible] March—not far off, ALL HANDS presents a brief roundup on who should pay what to the Bureau of Internal Revenue.

Income earned by members of the armed forces is generally subject to income tax. In some cases, the tax will be withheld for Navymen by the Navy. In other cases, it is up to the individual to list a specific item as income and pay the proper tax.

The following items of Navy income are subject to withholding tax:

- Basic pay—including base pay plus "longevity" (periodic pay increases).
- Sea pay, foreign service, flight, submarine, diving, and other hazardous duty pay, including $100 per month to doctors and dentists.
- Retired pay, generally, if retired for other than physical disability. (See exclusions.)

Items of income which are subject to income tax but on which no tax is automatically withheld at source are as follows:

- Pay for accrued leave on separation. (But not the amount representing quarters or subsistence.)
- Reenlistment bonus.
- Battle efficiency prizes.
- Credit for back pay.
- *Lump sum payment made* to former naval aviation cadets.
- Travel allowance for mileage. (Servicemen should deduct actual expenses and pay income tax on remainder, if any.)
- Interest earned on savings accounts deposited.
- In the case of a commissioned *officer above the rank of chief war*rant officer, the excess of $200 per month while entitled *to a* "combat zone" exclusion.

Exclusions are made of the following items of income (that is, the income listed below is not subject to tax and should not be reported on the *tax form):*

- Certain allowances—including subsistence, quarters, rental and family allowances contributed by the government, per diem allowance in lieu of subsistence.
- Retired pay computed on basis of *physical* disability. However, if an individual retired for a physical *disability resulting from active serv*ice elects to receive retired pay computed on basis of longevity, he must pay income tax on that amount of his retirement pay which exceeds the amount computed on the basis of his physical disability. In other words, if—for example—his disability retirement pay is $150 monthly, computed on basis of longevity, and if his retirement pay would be $50 com*puted on the basis of his* physical disability, the $50 would be tax-exempt but he would have to pay income tax on the remaining $100.
- Mustering out pay of enlisted personnel.
- Uniform gratuity or allowance paid to officers, nurses or enlisted personnel.
- Veterans' pensions received from the United States by a veteran or by his family. Pensions paid by a *state* for services *are* subject to federal *income* tax.
- Insurance dividends, including special dividends received from NSLI and USGLI insurance as well as dividends from commercial life insurance policies.
- Benefits received under the G.I. Bill—including unemployment compensation, disability pensions and compensation, educational benefits, vocational rehabilitation, on-the-job training, etc.
- State bonuses for services to the *Federal Government.*
- Amounts received under life insurance policies in case of death of the insured, paid either by the government or private companies.
- Soldier's Bonus — paid under World War Adjusted Compensation Act.
- Social Security benefits—including amounts received from the federal or state governments under the Federal Social Security program.
- Proceeds from surrendered government insurance policies.
- Proceeds and *dividends* from government endowment insurance policies.

In addition, all income from sev

HOW DID IT START

Scuttlebutt

"Scuttlebutt," the sailor's word for an unauthenticated rumor, combines the term "scuttle butt," the name for the casks of drinking water carried in old-time vessels, and around which the crew would gather to exchange views and gossip while awaiting their turn at the fresh water.

Strictly speaking, to "scuttle" means to make an opening below decks to permit the inflow of water, causing a ship to sink. A "butt" is a cask or hogshead. Thus, a "scuttle butt" is a cask with a hole in it of some sort.

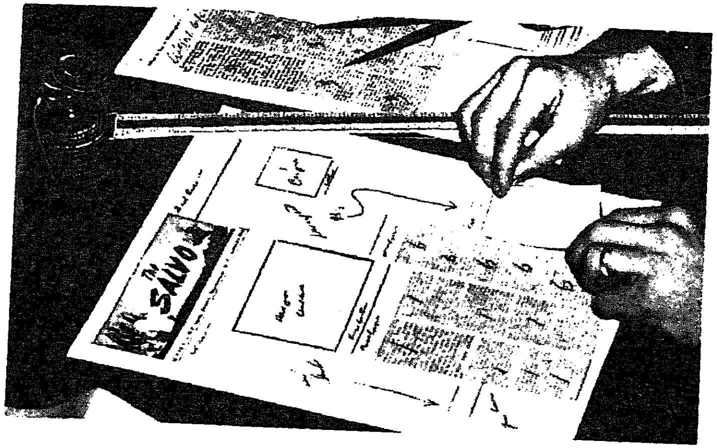
In addition to the large oaken casks, filled before setting forth on a voyage, some vessels were equipped with smaller butts for convenient distribution about the crew's quarters. These could be filled through scuttles from the larger casks and often had spigots driven into another scuttle or hole in the lower side.

Somewhat more elaborate than the butts of early sailing days, was that of USS *United States*, described in an account of 1843 as follows: "The scuttle butt is a *goodly, round, painted cask, standing on end,* and with its upper head removed showing *a narrow circular shelf within where* rest a number of tin cups for the accommodation of the drinkers. Central within the scuttle butt itself stands an iron pump, which, connected with the immense water tanks in the hold, furnishes an unfailing supply of the much admired Adam's Ale. . . ."

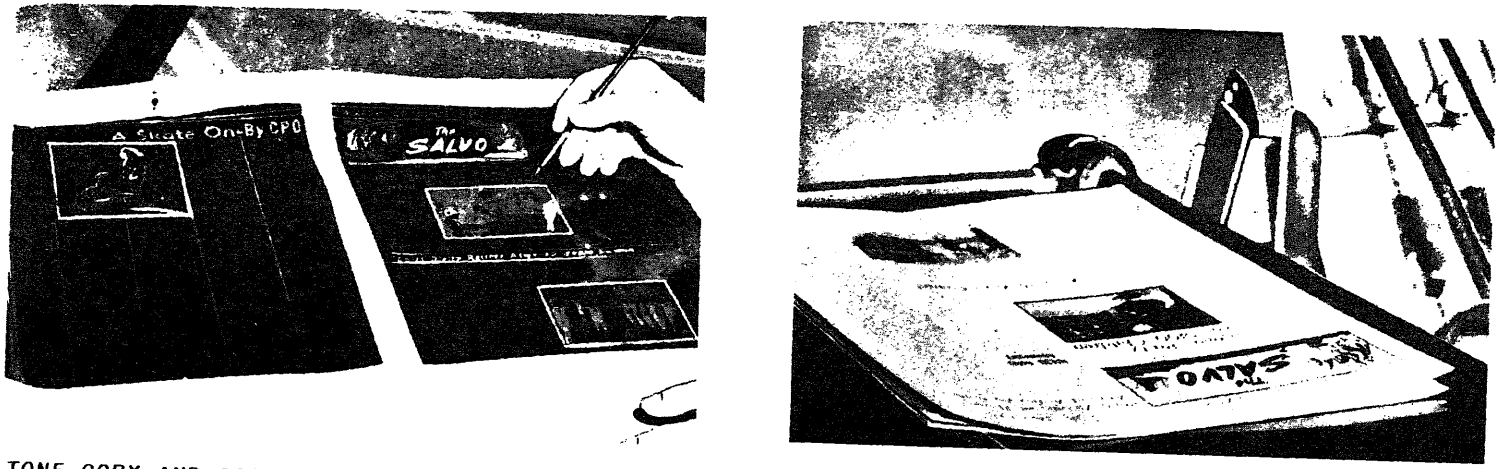
In sharp contrast to the old "butts" are the shiny electric drinking fountains found on today's ships, but these modern bubblers, in Navy lingo, still are referred to as scuttle butts. *Unsubstantiated rumor,* gossip or speculation remains pure scuttlebutt.

113.27

Figure 2-28.—Paste-up dummy for a magazine.



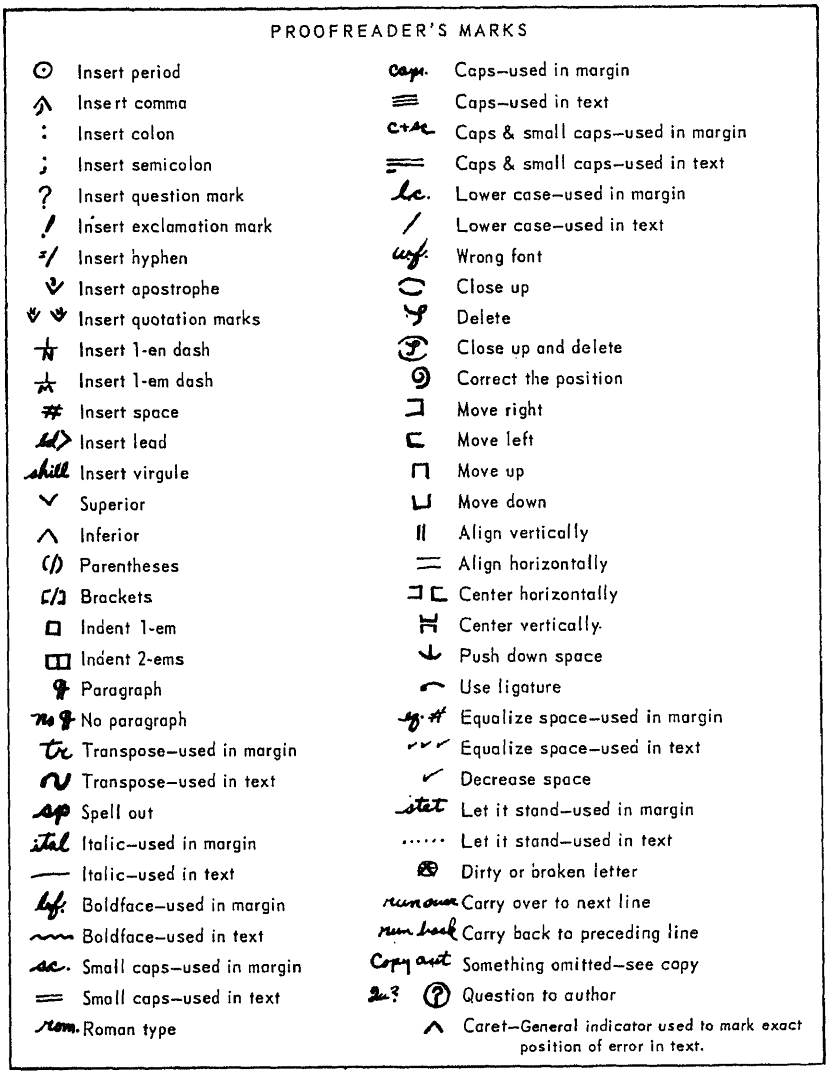
COMPOSITION IS THEN DONE FOR THE COPY OF THE NEWSPAPER PAGES. SAME SIZE LINE WORK MAY BE COMBINED WITH THE COPY ON LAYOUT SHEETS FOR CAMERA.



TONE COPY AND COPY REQUIRING REDUCTIONS MUST BE SHOT SEPARATELY AND STRIPPED INTO THE PAGE NEGATIVES.

AFTER THE STRIPPINS AND OPAQUING OPERATIONS ARE COMPLETED, THE NEGATIVE ASSEMBLY (FLAT) IS PRINTED ON AN OFFSET PLATE. THE PLATE IS THEN PUT ON THE PRESS AND PRODUCTION GETS UNDER WAY.

Figure 2-29.—How the paste-up dummy is used in the production of a Navy newspaper. 113.28



57.23

Figure 2-30.—Proofreader's marks.

shows copy preparation symbols accepted by the printing trade all over the United States. Although these symbols are used by both editors and printers, they are referred to as proofreader's marks.

You should study these symbols and use them in your work whether your copy is typed on a typewriter or prepared on a composing machine. If you are marking copy, the symbols enable you to convey your instructions to the compositor; and if you are doing the composition, they show you how to do the composing correctly.

Preliminary Operations

Most jobs will come to you as a stack of loose manuscript pages and artwork. In marking or preparing the copy for cold type composition you should complete one step at a time.

Step 1 - Check through the copy several times to ensure that all the pages are in their proper sequence and that all the art has been furnished.

If the copy for the cover is furnished, WRITE the word *Cover* in the upper left corner of the cover page. ENCIRCLE the word so the compositor will not confuse it with the copy.

If the cover is a piece of artwork, WRITE on a blank piece of paper the same size as the manuscript page, *Cover—see artwork submitted*. This page will then become No. 1 when you begin numbering the pages in the manuscript.

Step 2 - Number the pages so it will be easy to keep the pages in their proper order.

Step 3 - Write the word *All* and ENCIRCLE it at the end of the last page.

Step 4 - Stamp a job number or some other form of identification on each page of the manuscript, if necessary.

> NOTE
>
> Use a checkoff list to help ensure that you don't forget or miss any one of the important steps.

Marking Type Styles, Sizes, and Illustrations

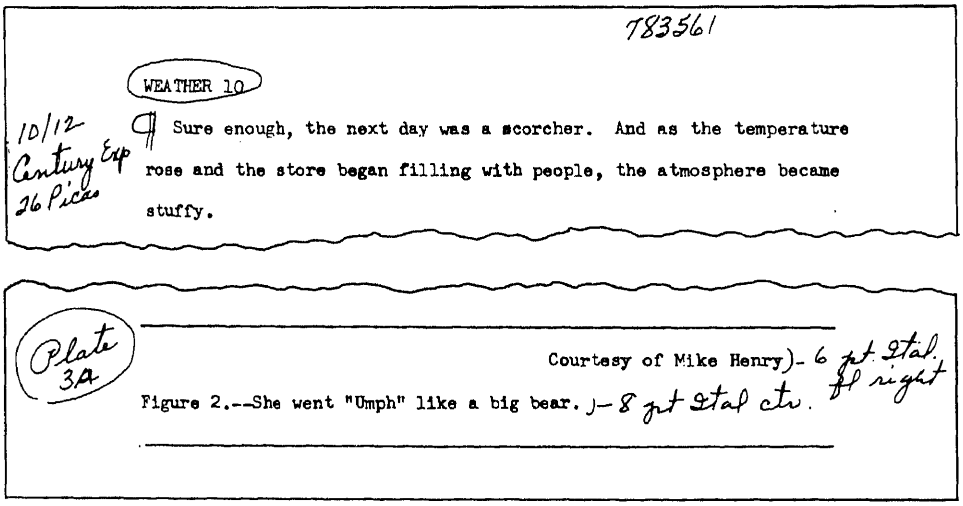
Once you have completed each preliminary step, you can begin marking the type styles and sizes. Either stamp or write in the upper left corner of each page, the type style and size, the line spacing desired, and the width of the line, as shown in figure 2-31.

The legends and other display lines must also be marked. In most cases, heads follow a certain pattern, similar to the outline of a book. For example, the main heads may be set in 10 point caps, and subheads may be set in 10 point caps and lowercase, or in 8 point caps, depending on their importance.

Check legend against artwork for accuracy. Key the artwork into the manuscript by inserting a notation, such as *Illustration No. __ to be inserted here*. Or, simply write and encircle in the margin of the legend the plate number assigned to the artwork.

When you are preparing material for cold type composition, you may also wish to include the size of each illustration and whether it is line or tone. This notation will indicate how much space should be left for the illustration when the compositor prepares the text.

Always check each piece of artwork to make sure that it doesn't happen to be copyrighted material. Never use copyrighted material without written permission. If you have written permission to use a copyrighted illustration, be sure to insert a credit line to



783561

WEATHER 10

10/12
Century Exp
26 Picas

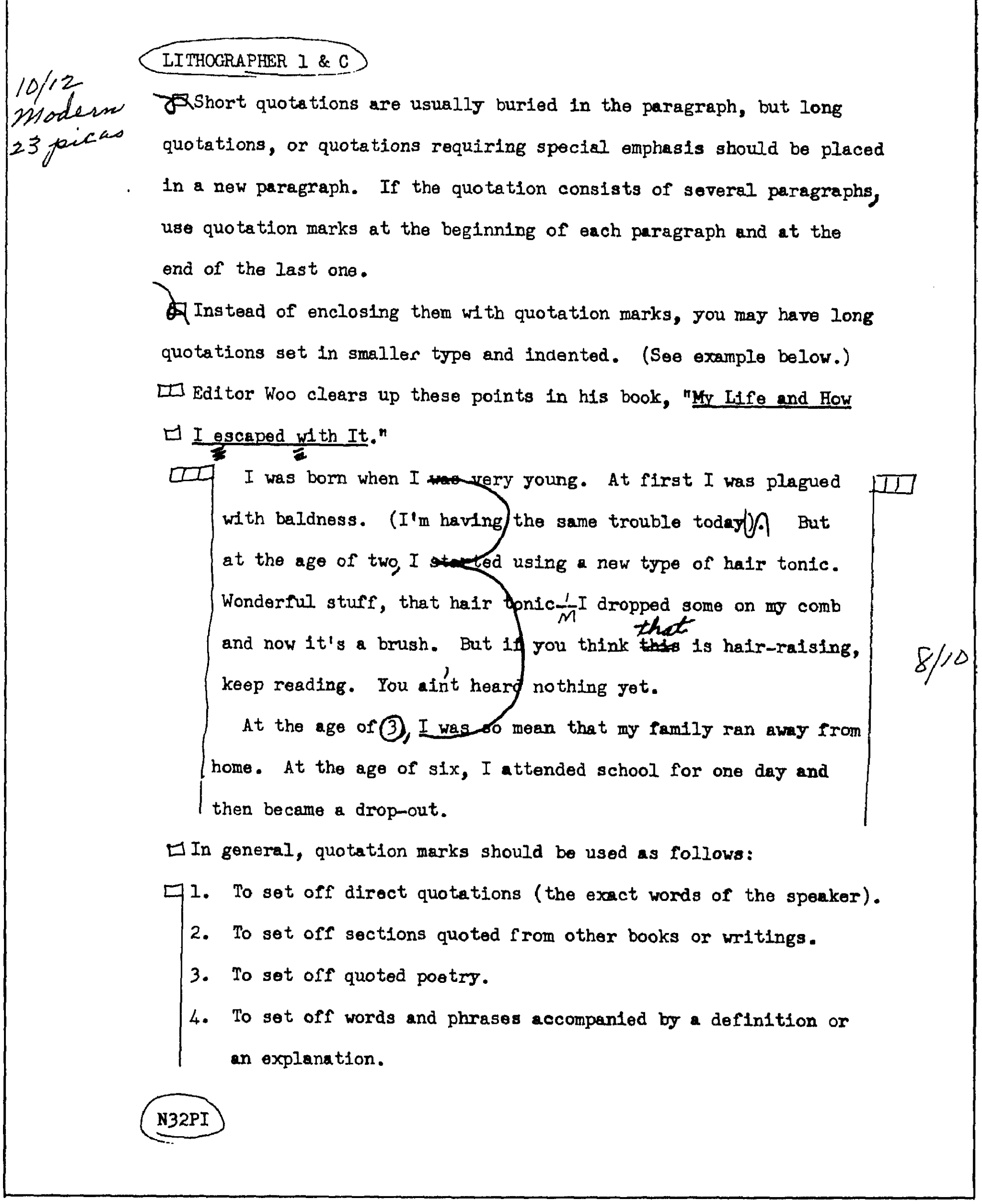
¶ Sure enough, the next day was a scorcher. And as the temperature rose and the store began filling with people, the atmosphere became stuffy.

Plate 3A

Courtesy of Mike Henry)- 6 pt Ital. fl right

Figure 2.--She went "Umph" like a big bear.)- 8 pt Ital ctr.

113.30



LITHOGRAPHER 1 & C

10/12
Modern
23 picas

¶ Short quotations are usually buried in the paragraph, but long quotations, or quotations requiring special emphasis should be placed in a new paragraph. If the quotation consists of several paragraphs, use quotation marks at the beginning of each paragraph and at the end of the last one.

¶ Instead of enclosing them with quotation marks, you may have long quotations set in smaller type and indented. (See example below.)

□□ Editor Woo clears up these points in his book, "My Life and How I escaped with It."

□□□ I was born when I ~~was~~ very young. At first I was plagued with baldness. (I'm having the same trouble today). But at the age of two, I ~~start~~ed using a new type of hair tonic. Wonderful stuff, that hair tonic—I dropped some on my comb and now it's a brush. But if you think ~~this~~ that is hair-raising, keep reading. You ain't heard nothing yet. □□□

8/10

At the age of ③, I was so mean that my family ran away from home. At the age of six, I attended school for one day and then became a drop-out.

□ In general, quotation marks should be used as follows:

□ 1. To set off direct quotations (the exact words of the speaker).
2. To set off sections quoted from other books or writings.
3. To set off quoted poetry.
4. To set off words and phrases accompanied by a definition or an explanation.

N32PI

113.31

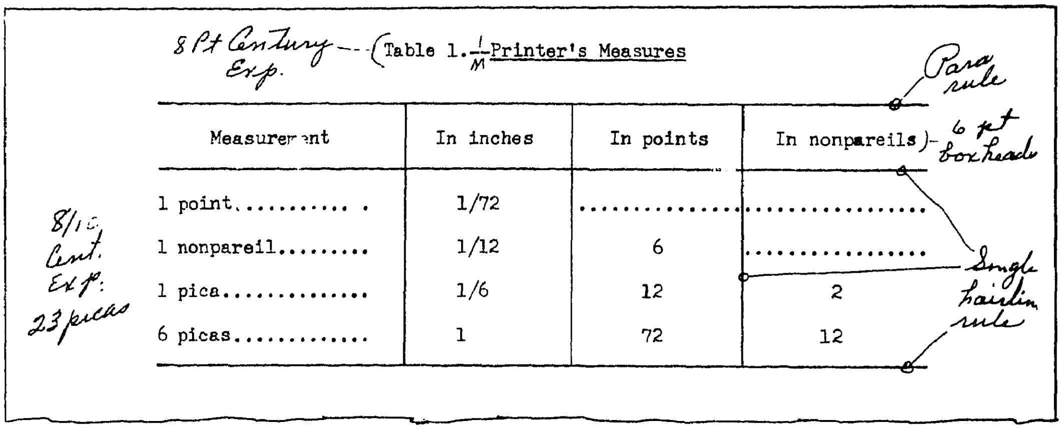
Figure 2-32.—In marking paragraphs, you can use the paragraph sign (¶) or the em square (□). Two em squares (□ □) mean that the paragraph should be indented 2 ems. It is not necessary to mark every paragraph on the page if the indentions follow a set pattern. In the page above, the numbered listings 1 through 4 have been marked for a 1-em indention. In some cases, numbers 1 through 9 are indented a "nut" space and numbers beginning with 10 are flush. This arrangement provides for the alignment of the figures when they are set in type. The "3" written through the quoted matter is actually one side of the figure "8." It is used to call the printer's attention to the fact that the material is to be set in 8-point type.

indicate its source. Also include a listing of all copyrighted material by page in an acknowledgment page.

You should also check the artwork to make sure that it is complete, that it will reproduce properly, and that it is scaled to the proper dimensions.

Marking Indentions and Tables

After you have marked type styles and sizes, you should go through the copy again and mark indentions. It is not necessary to mark paragraphs if they have been clearly indicated in type, but any unusual indentions should be marked, as shown in figure 2-32.



8 Pt Century Exp. — (Table 1.—Printer's Measures

Para rule

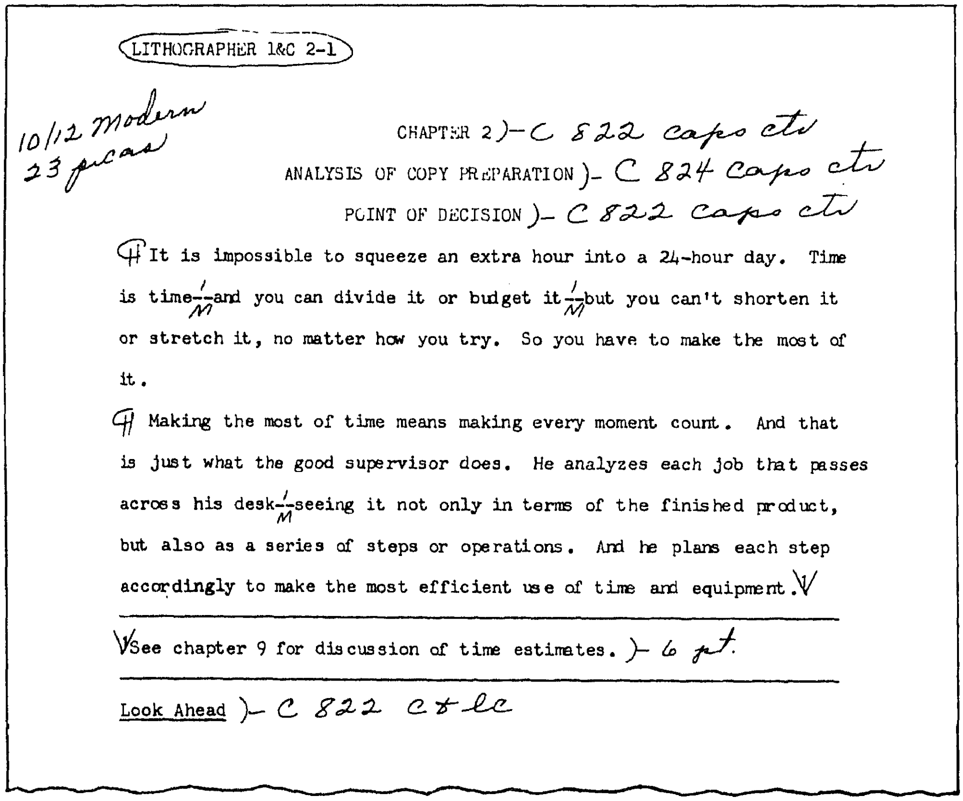
Measurement	In inches	In points	In nonpareils)— 6 pt boxheads
1 point...........	1/72	....	....
1 nonpareil.........	1/12	6	....
1 pica..............	1/6	12	2
6 picas............	1	72	12

Single hairline rule

8/10 Cent. Exp. 23 picas

113.32

Figure 2-33.—One way to mark a table for the printer. Tables are often set in one size of type smaller than that used for the text of the book, and boxheads are set in one size smaller than that used for the body of the table. Tables should be numbered consecutively throughout a publication. Most printers use a parallel rule at the top of the table and a single hairline rule at the bottom.



LITHOGRAPHER 1&C 2-1

10/12 Modern 23 picas

CHAPTER 2)— C 822 caps ctr

ANALYSIS OF COPY PREPARATION)— C 824 Caps ctr

POINT OF DECISION)— C 822 Caps ctr

¶ It is impossible to squeeze an extra hour into a 24-hour day. Time is time—and you can divide it or budget it—but you can't shorten it or stretch it, no matter how you try. So you have to make the most of it.

¶ Making the most of time means making every moment count. And that is just what the good supervisor does. He analyzes each job that passes across his desk—seeing it not only in terms of the finished product, but also as a series of steps or operations. And he plans each step accordingly to make the most efficient use of time and equipment.∨

∨See chapter 9 for discussion of time estimates.)— 6 pt.

Look Ahead)— C 822 c+lc

113.33

Figure 2-34.—Marking headings and footnotes. The copy preparer has used a number code for designating display type. Instead of having been marked "10 pt. Sans Serif Caps" the heading has been marked "C. 822 Caps." The printer's cases carry similar numbers, and when printers see this marking they will set the heading from the case with the corresponding number.

Figure 2-33 shows how to mark tables.

Marking for Clarity

Ensure that all words to be done in italics, small caps, and caps are properly designated. (See fig. 2-34.) You can indicate to the printer that you want the word set in italics by underlining the word with pencil. Two underlines mean that the word should be set in small caps, and three underlines mean that it should be all caps. Four underlines signify italic caps, and a wavy underline means that the word should be set in boldface.

You should also mark those things that are not readily understood so there will be nothing left for the compositor to question. Emphasize such things as mathematical symbols, Greek letters, and so on, by writing a brief explanation in the margin of the page where each occurs. Encircle the marginal note (so the compositor will not confuse it with the copy) and draw a tie line or an arrow from the explanation to the word, symbols, or letter to which it applies.

The number one (1), the cipher (0), the multiplication sign (x), the dash (-), and so on, should be clearly marked. Words that do not follow the usual spelling or capitalization, or words that printers might mistake for typing errors and change under the impression that they are doing you a favor, should be marked *set* or *follow*.

In marking an abbreviation or a number that is to be spelled out, you may either write it out or simply encircle it. However, if the abbreviation is uncommon or might be misunderstood, it should be written out.

After the copy preparation is complete, you should run through the entire job once more to make sure that the marking is consistent. You may also check over the copy to see that it is consistent in punctuation, capitalization, compounding, spelling, and so on, but this is really an editor's job and is unnecessary if the work has been properly edited.

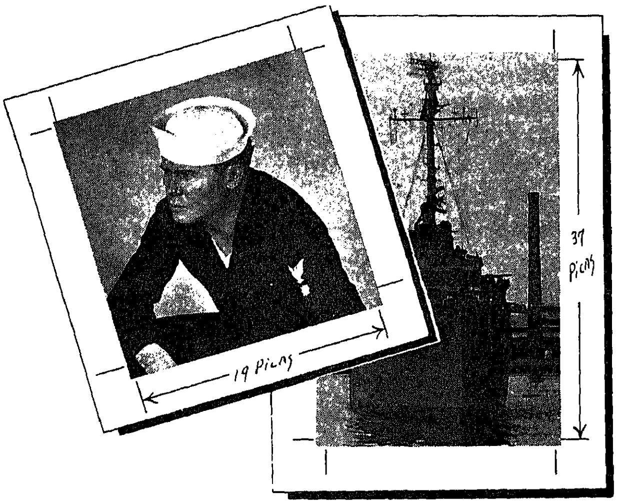
TONE DRAWINGS AND PHOTOGRAPHS

Tone drawings and photographs must be crisp, sharp, and clear if they are to reproduce well. Glossy photographs are better than matte finished prints. And faded or blurred prints should not be used.

If you want to reproduce only a portion of an illustration or photograph, the unessential parts should be cropped (marked off). There are several methods for cropping. The most common method is to mark the picture in the margins with ink, in the manner shown in figure 2-35. Ink crop marks should never run into or through the copy, of course. If the copy does not have margins, you should mount it on a larger sheet and make your crop marks in the margins of the larger sheet.

You may indicate the area of a photograph or tone drawing to be used by covering the copy with a piece of white paper and cutting a window to expose the desired area. Although Chinese white is not recommended, it may be used for outlining the area of a photograph. Since Chinese white is a water color, it can be removed from the photograph later, if necessary. A grease pencil may also be used in drawing crop marks, but it, too, is not recommended because the grease marks might smear and transfer to other artwork or to the glass on the copyboard.

Sizing should be marked at the bottom or along the right margin if the art is to be reduced or enlarged. The new width must be marked in the margin, as shown in figure 2-35. If no reduction or enlargement is required, write *same size* in the margin. Tone drawings are generally prepared for one-half or one-third reduction. They are seldom enlarged because



113.34

Figure 2-35.—Crop marks are made in the margins of the copy to show the camera operator the area to be used.

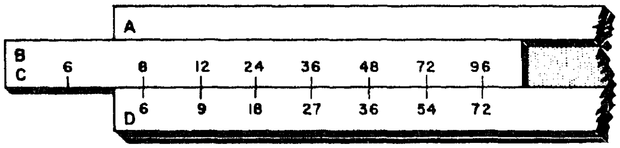
enlarging magnifies defects in the work. Original photographs may be enlarged if necessary; but clippings of halftones are rarely enlarged, because enlarging increases the size of the halftone dots.

If an illustration is to fit into a given space, you should scale it to calculate its depth after enlargement or reduction so you can be sure that it will fit into the space allotted to it. Once you have the new width, you can calculate the depth mathematically, using a scaling wheel or a slide rule.

On the slide rule shown in figure 2-36, scales A and B are marked in inches and scales C and D are marked in picas. To use, move the slide until the number indicating the old width rests directly above the number indicating the new width. Then find the number indicating the old depth. The number directly below it will show the new depth of the job after it has been enlarged or reduced. If the original art is 48 picas wide and 24 picas deep and is to be reduced to a width of 36 picas, the new depth will be 18 picas as shown on scale D in the illustration above. The new depth could be found just as well with the scales reversed—that is, with scale D representing the old width and scale C representing the new one. The circular scaling wheel is similar to the slide rule in principle.

You will find that it is sometimes necessary to have a photograph retouched to bring out details, to remove the background, or to increase the contrast. Most retouching is done with a brush and a set of gray retouching watercolors, but an airbrush may be used to provide soft gradations of tone and perfectly smooth backgrounds. Photographs are often mounted on heavy illustration board and are protected by a paper flap or cover.

When original drawings are not available, photographs of the originals may be used as copy.



45.52

Figure 2-36.—Slide rule.

You may also use clippings from newspapers and books for copy; however, clippings never reproduce as well as the originals.

Line Drawings

Since line drawings are generally prepared for one-half or one-third reduction, pen lines should be clear and open so they will not fill in when the drawing is reduced. Charts and lettering should be planned so they will match the size of the other drawings and lettering in the publication when they are reduced. If original line drawings are not available, clippings or photographs of original drawings may be used as copy.

Combination Art

In combination work, the tone portion of the copy is generally prepared or mounted on heavy illustration board and the line portion is drawn or pasted on an acetate overlay. The acetate overlay is attached to the base drawing after it is keyed with registration marks.

If a reverse combination (white letters against a black or tone background) is required, a reproduction proof of the lettering is pasted on illustration board and a border line is ruled in to indicate the dimensions of the dark area. The camera operator is then instructed to make a positive that will produce a "reverse plate".

Color Work

When line illustrations are to be printed in color, a simple black-and-white drawing is all that is required if the colors do not overlap. The artist attaches a tissue overlay to the original drawing and indicates on the tissue the areas that are to go in color and the colors to be used. The camera operator then makes a single negative from the drawing, and the stripper breaks the negative for color before the plates are made. For the first plate, the stripper uses goldenrod paper and/or opaque to block out all areas of the negative that are not to print in one particular color. For the second plate, the stripper adds masks for areas that are not to run in the second color. If a third color is desired, the same procedure is followed for the third plate, and so on.

If the colors are to overlap, the artist makes a key drawing in black and white on a sheet of illustration board. Then, the artist attaches an acetate overlay to the key drawing and draws on the acetate the parts of the illustration that are to be printed in the second color. If several colors are to be run, a separate keyed overlay is used for each additional color.

> NOTE
>
> When you receive a request to reproduce color work, always refer to the current *Department of the Navy Publications and Printing Regulations*, NAVSO P-35, to see if you can legally reproduce the job in color.

MARKING ART FOR THE CAMERA OPERATOR

Besides checking to see that the artwork has been properly prepared, you should also

- check the instructions for the camera operator to see that they are clear and complete.
- ensure that crop marks are plainly indicated.
- ensure that illustrations are properly scaled and marked for size.

> REMEMBER: Photographs may be shot same size or they may be enlarged or reduced, but practically all other types of work are at their best only when they are shot same size or reduced.

- ensure that special instructions for insets, tint blocks, reverses, and so on, are clear and that overlays have been properly marked.
- check the acetate overlays of illustrations to go in color to see that they are marked with the proper color designations; that is, as red plate, blue plate, and so on. The original drawings and the overlays should carry keyed registration marks so that the plates can be registered in printing. Color swatches may be attached to the original drawing to illustrate the colors to be used.
- make sure that each piece of art is marked or stamped line, halftone, or combination, according to the preferred reproduction treatment. Tone copy should also be marked outline, square finish, or vignette to show the opaquer or engraver the type of finish required.
- check the art to see if it is marked for identification by the title of the job and a figure number. Plate numbers are assigned to the art independent of the figure numbers.

For example, if the cover of a pamphlet consists of artwork, it will be plate 1; figure 1 may then be plate 2, and so on. Assemble all the pieces of art in sequence and then number them consecutively, writing the appropriate plate number on the flap or cover attached to each illustration.

CHECKING PASTE-UPS

As you know, work is generally assembled and pasted into pages or into the largest possible units before it is passed on to the camera operator. All pieces of same-size line copy can be pasted together on a layout sheet, but tone copy or line copy that requires various enlargements or reductions must be submitted separately.

Cold type composition is generally pasted on a sheet of illustration board that has been ruled with blue pencil to show the type area, trim size, bleed, and column widths. Column rules, borders, and other elements that are to be retained when the copy is photographed should be ruled in with a ruling pen and india ink before the paste-up is begun.

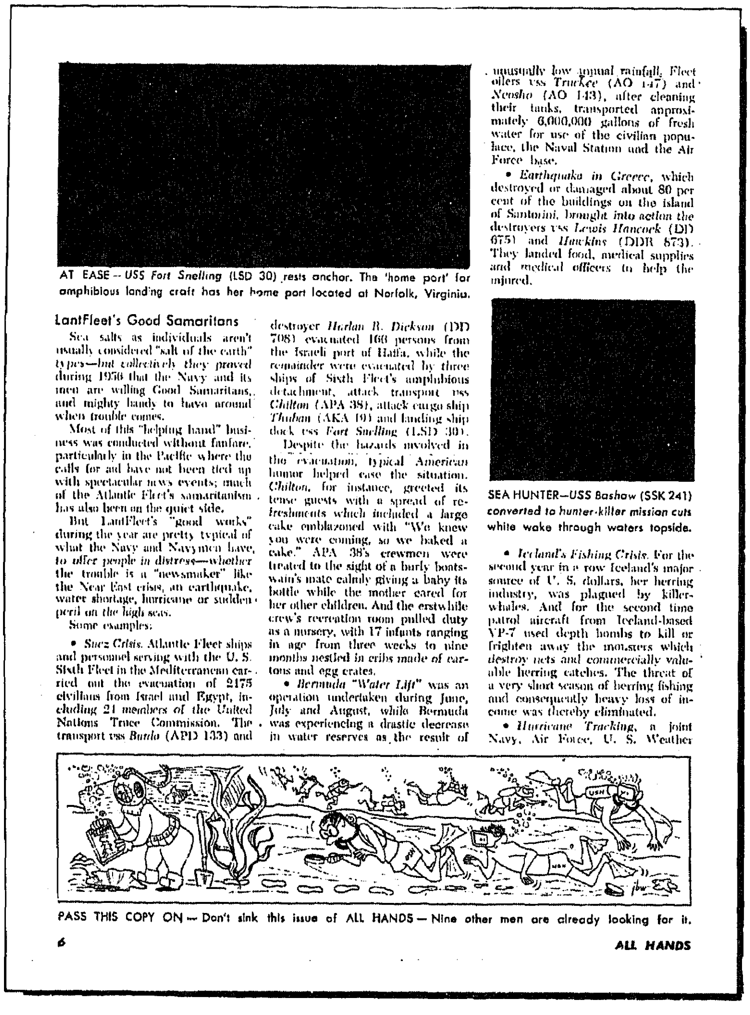
If the cold type composition has been prepared on a wide measure so that it can be reduced when it is photographed, the entire layout must be enlarged proportionately, because a reduction in the width will also result in a reduction in the length of the columns. You should scale such work to see that it will come down to the proper dimensions. Line drawings that have also been proportionally scaled may be mounted in their proper places along with the type.

Some operators place a piece of black paper over the area where a tone illustration or linework requiring a change in size is to go. (See fig. 2-37.) If a dummy has not been provided, they attach a tissue overlay to the master copy and indicate on the tissue which illustration is to go in each masked area. If made directly on the black patches, the marks may not reflect light and may show up in the negative.

Besides checking the paste-up layouts for spacing and general appearance, you should also examine the lettering to see that there are no smears or imperfect letters. Imperfect letters should be touched up with india ink or Chinese white water color.

When checking a publication, you may be working from preprinted layout sheets as shown in figure 2-38. These layout sheets are printed with light blue nonphotographic ink on paper stock equal in bulk and rigidity to a 28-pound ledger stock. The copy has been typed directly on the layout sheet, and blank spaces have been left in areas where reduced or enlarged illustrations will appear. Same-size line illustrations will have already been pasted in, making the layout easier to check. Because of the standard format of the publication page, there is no need to check the margins, space between columns, and length or width of columns. However, you will still have to check for legibility, spelling, punctuation, and page numbering.

Note: When you are checking reduction, your entire layout must be enlarged proportionately. This means that the spaces left for illustrations on the typed page will be larger than the spaces



AT EASE—*USS Fort Snelling* (LSD 30) rests anchor. The 'home port' for amphibious landing craft has her home port located at Norfolk, Virginia.

LantFleet's Good Samaritans

Sea salts as individuals aren't usually considered "salt of the earth" types—*but collectively they proved* during 1956 that the Navy and its men are willing Good Samaritans, and mighty handy to have around when trouble comes.

Most of this "helping hand" business was conducted without fanfare, particularly in the Pacific where the calls for aid have not been tied up with spectacular news events; much of the Atlantic Fleet's samaritanism has also been on the quiet side.

But LantFleet's "good works" during the year are pretty typical of what the Navy and Navymen have *to offer people in distress*—whether the trouble is a "newsmaker" like the Near East crisis, an earthquake, water shortage, hurricane or sudden peril on the high seas.

Some examples:

- *Suez Crisis.* Atlantic Fleet ships and personnel serving with the U. S. Sixth Fleet in the Mediterranean carried out the evacuation of 2175 civilians from Israel and Egypt, including 21 *members of* the United Nations Truce Commission. The transport USS *Burdo* (APD 133) and destroyer *Harlan R. Dickson* (DD 708) evacuated 168 persons from the Israeli port of Haifa, while the remainder were evacuated by *three* ships of Sixth Fleet's amphibious detachment, attack transport USS *Chilton* (APA 38), attack cargo ship *Thuban* (AKA 19) and landing ship dock USS *Fort Snelling* (LSD 30).

Despite the hazards involved in the evacuation, typical *American* humor helped ease the situation. *Chilton*, for instance, greeted its tense guests with a spread of refreshments which included a large cake emblazoned with "We knew you were coming, so we baked a cake." APA 38's crewmen were treated to the sight of a burly boatswain's mate calmly giving a baby its bottle while the mother cared for her other children. And the erstwhile crew's recreation room pulled duty as a nursery, with 17 infants ranging in age from three weeks to nine months nestled in cribs made of cartons and egg crates.

- *Bermuda "Water Lift"* was an operation undertaken during June, July and August, while Bermuda was experiencing a drastic decrease in water reserves as the result of unusually low annual rainfall. Fleet oilers USS *Truckee* (AO 147) and *Neosho* (AO 143), after cleaning their tanks, transported approximately 6,000,000 gallons of fresh water for use of the civilian populace, the Naval Station and the Air Force base.
- *Earthquake in Greece*, which destroyed or damaged about 80 per cent of the buildings on the island of Santorini, brought *into action* the destroyers USS *Lewis Hancock* (DD 675) and *Hawkins* (DDR 873). They landed food, medical supplies and medical officers to help the injured.

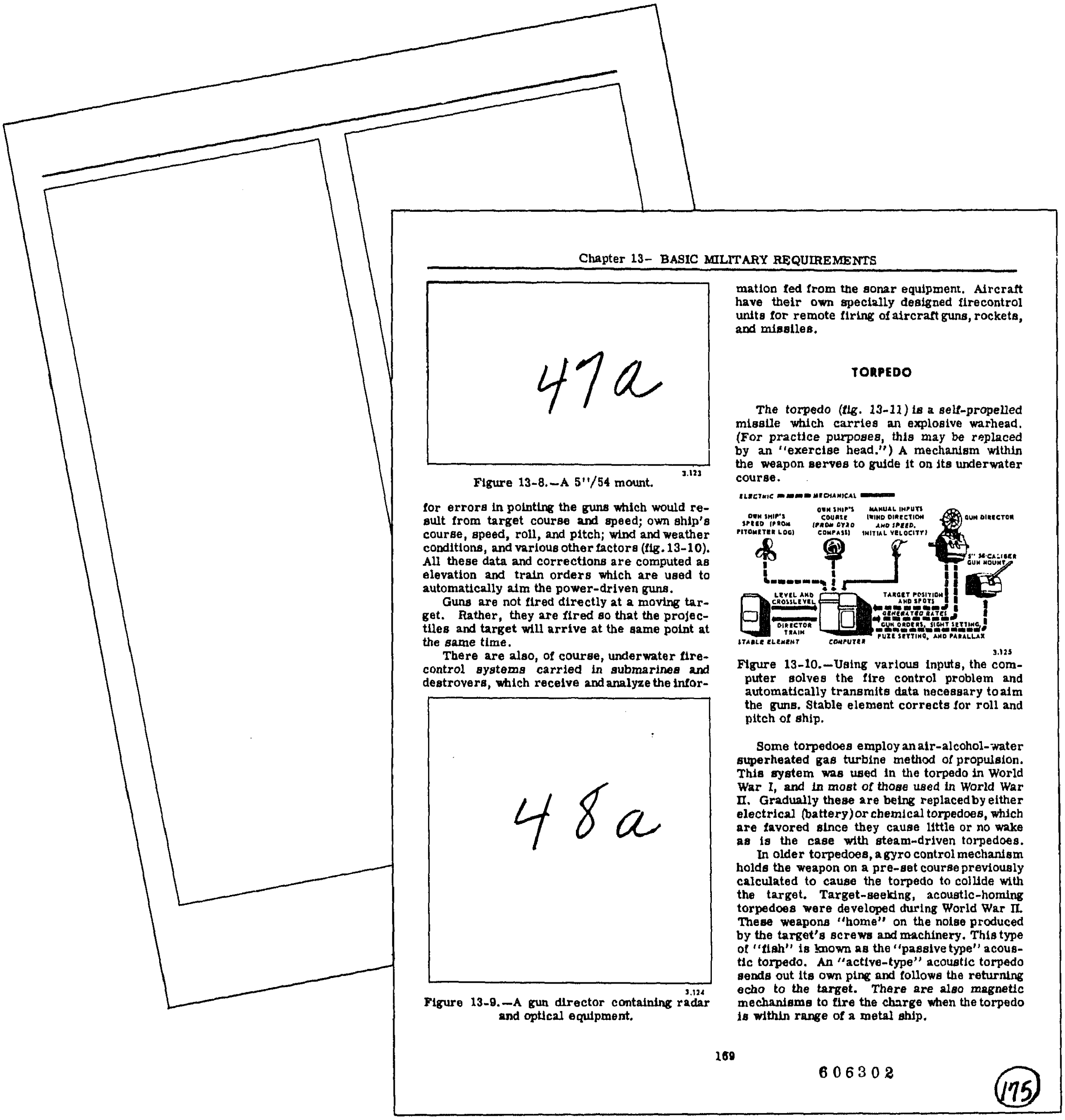
SEA HUNTER—USS *Bashaw* (SSK 241) *converted to hunter-killer mission cuts* white wake through waters topside.

- *Iceland's Fishing Crisis.* For the second year in a row Iceland's major source of U. S. dollars, her herring industry, was plagued by killer-whales. And for the second time patrol aircraft from Iceland-based VP-7 used depth bombs to kill or frighten away the monsters which *destroy nets and commercially valuable* herring catches. The threat of a very short season of herring fishing and consequently heavy loss of income was thereby eliminated.
- *Hurricane Tracking*, a joint Navy, Air Force, U. S. Weather

PASS THIS COPY ON — Don't sink this issue of ALL HANDS — Nine other men are already looking for it.

6

ALL HANDS



Chapter 13– BASIC MILITARY REQUIREMENTS

47a

3.123
Figure 13-8.—A 5"/54 mount.

for errors in pointing the guns which would result from target course and speed; own ship's course, speed, roll, and pitch; wind and weather conditions, and various other factors (fig. 13-10). All these data and corrections are computed as elevation and train orders which are used to automatically aim the power-driven guns.

Guns are not fired directly at a moving target. Rather, they are fired so that the projectiles and target will arrive at the same point at the same time.

There are also, of course, underwater firecontrol systems carried in submarines and destroyers, which receive and analyze the information fed from the sonar equipment. Aircraft have their own specially designed firecontrol units for remote firing of aircraft guns, rockets, and missiles.

48a

3.124
Figure 13-9.—A gun director containing radar and optical equipment.

TORPEDO

The torpedo (fig. 13-11) is a self-propelled missile which carries an explosive warhead. (For practice purposes, this may be replaced by an "exercise head.") A mechanism within the weapon serves to guide it on its underwater course.

ELECTRIC
MECHANICAL
OWN SHIP'S SPEED (FROM PITOMETER LOG)
OWN SHIP'S COURSE (FROM GYRO COMPASS)
MANUAL INPUTS (WIND DIRECTION AND SPEED, INITIAL VELOCITY)
GUN DIRECTOR
5" 38-CALIBER GUN MOUNT
LEVEL AND CROSSLEVEL
DIRECTOR TRAIN
TARGET POSITION AND SPOTS
GENERATED RATES
GUN ORDERS, SIGHT SETTING, FUZE SETTING, AND PARALLAX
STABLE ELEMENT
COMPUTER

3.125
Figure 13-10.—Using various inputs, the computer solves the fire control problem and automatically transmits data necessary to aim the guns. Stable element corrects for roll and pitch of ship.

Some torpedoes employ an air-alcohol-water superheated gas turbine method of propulsion. This system was used in the torpedo in World War I, and in most of those used in World War II. Gradually these are being replaced by either electrical (battery) or chemical torpedoes, which are favored since they cause little or no wake as is the case with steam-driven torpedoes.

In older torpedoes, a gyro control mechanism holds the weapon on a pre-set course previously calculated to cause the torpedo to collide with the target. Target-seeking, acoustic-homing torpedoes were developed during World War II. These weapons "home" on the noise produced by the target's screws and machinery. This type of "fish" is known as the "passive type" acoustic torpedo. An "active-type" acoustic torpedo sends out its own ping and follows the returning echo to the target. There are also magnetic mechanisms to fire the charge when the torpedo is within range of a metal ship.

169

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175

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Figure 2-38.—Preprinted layout sheets with a same-size line illustration pasted in place. Halftones and line illustrations that must be enlarged or reduced cannot be pasted on the preprinted layout sheet. They must be shot separately and spliced into the flat. Note that space has been left for halftone illustrations on the preprinted layout sheet shown here.

that appear on the master negative after the page is reduced. Unless you make proper allowance when figuring the spaces for your illustrations, negatives for illustrations that are shot separately and stripped into the page negative will not fit into the spaces allotted to them. If you plan to reduce the page 20 percent, for example, all dimensions of your original copy (including column widths and dimensions for illustrations) must be 20 percent greater than they will be after reduction.

FOLLOWING UP THE JOB

Your job involves more than just laying out the work and reviewing it for reproduction qualities. You must also follow up the job, making sure that the illustrations are properly made and stripped in place and that each department follows your written instructions on the job jacket or specification sheet in producing the work.

In offset work, you must check everything carefully before the plate is made. It will also be up to you to check the first proofs when the job is put on the press, but here you will be concerned largely with positioning and with printing defects. If close registration is required, you should always examine these proofs over a light table to ensure uniformity and registration.

INVITATIONS, PLACE CARDS, AND NOTEPAPER

Certain Navy military officials as well as civilian masters of Military Sealift Command (MSC) ships are required to conduct official social functions in performance of their duties while in foreign countries. They also entertain dignitaries in U.S. ports. To carry out such official functions, the Secretary of the Navy has made available, through the Navy Supply System, plain and printed invitations, notepaper, appropriate envelopes, and table place cards.

Invitations, notepaper, envelopes, and table place cards are available for issue to flag officers, diplomatic duty intelligence officers, diplomatic duty mission officers, commanding officers of destroyer-type and large combatant ships and amphibious force flagships, commanding officers of shore-based activities, squadron and flotilla commanders, and civilian masters of Military Sealift Command (MSC) ships. As the supervisor of a Navy printing plant, you will not, under normal circumstances, be expected to order or stock such items yourself. You should, however, be familiar with the procedures used for procuring these items and, if necessary, relay the information to the yeomen who are concerned with obtaining the necessities of official social functions.

Figure 2-39 shows a set of matched items available for use by a flag officer. Matched items are also available with other insignia (flag, commissioning pennant, cap device, or MSC seal). *The Social Usage and Protocol Manual* gives specifications for setting and utilizing these items.

SPECIFICATION SHEETS

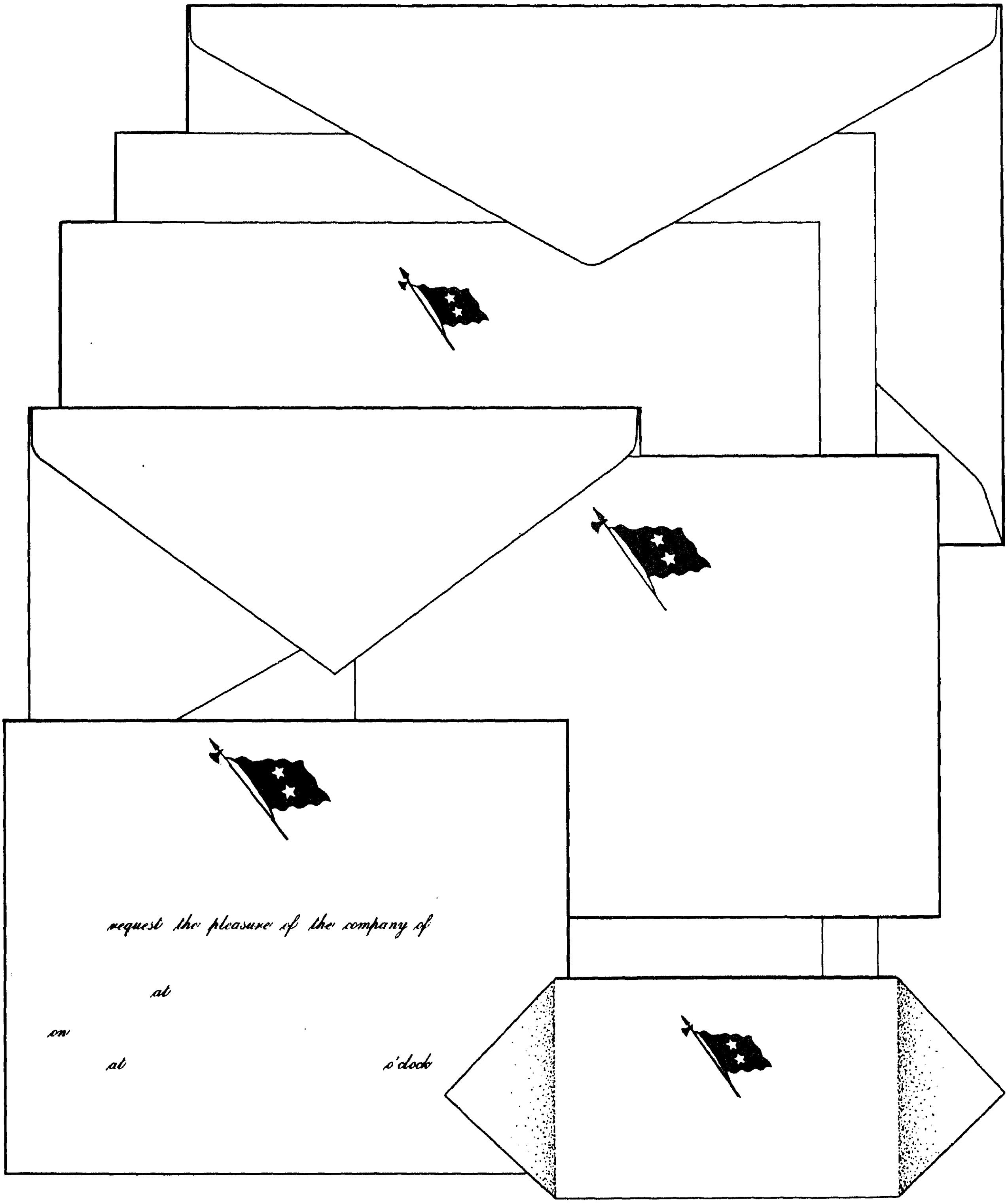
The overall specifications, such as the paper to be used, the color of ink, the number of plates, and other necessary information, are generally indicated on a specification sheet that is then attached to the job. The specification sheet contains all the information that each department or individual needs to do the job. In many shops the specification sheet also serves as the job order. This sheet should be prepared in duplicate so the original can accompany the job and the copy can be kept for filing. Whenever possible, the dummy and copy are placed in a large envelope to protect them and to facilitate handling. The specification sheet can be attached to, or printed on the outside of the envelope so the job can be readily identified.

In a later chapter you will find an expanded discussion on specification sheets, job orders, and job controls.

SELECTING THE TYPE

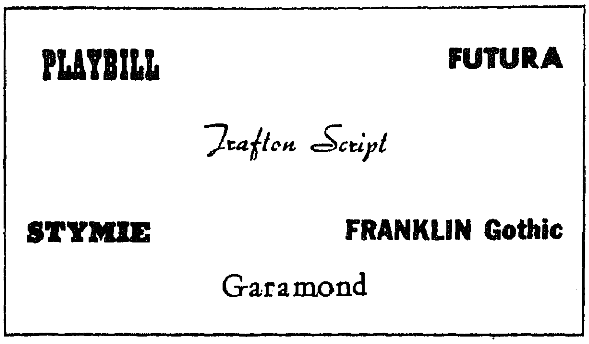
When you choose typefaces, you should select styles that are appropriate and that seem to match the mood expressed by the copy. As you know, typefaces reflect certain characteristics, such as refinement, dignity, boldness, and strength, and you can use the typefaces to emphasize or suggest the thoughts expressed by the copy.

Take the specimens shown in figure 2-40, for example. When you see the word *Playbill* you might immediately think of the days of gaslights, the iron horse, the gold rush, and nickel cigars. The line of Futura might remind you of the severity of our modern architecture and the hustle and bustle of everyday living in our streamlined generation. The line of Stymie suggests power and strength, and you might think of the steel girders that support our skyscrapers or of the tremendous horsepower created by our modern engines.


request the pleasure of the company of
at
on
at
o'clock

21.4

Figure 2-39.—You should order invitations, place cards, notepaper, and matching envelopes through regular supply channels. Additional wording to complete the invitations should be entered by hand.



113.2

Figure 2-40.—Type can be used to convey the tone or feeling expressed by the copy.

The line of script suggests fashion and feminine allure. The line of Franklin Gothic might remind you of the standard bread-and-butter items, such as the tools and commodities that we use. The line of Garamond suggests stability and dignity; it is one of the typefaces of tradition.

Typefaces

Did you ever stop to think about the many different kinds of handwriting there are? Some handwritings are large and bold; some are small and weak; some are clear—and some are almost illegible. Typefaces (called type styles) are much the same.

The first concern of a printer in selecting type is, of course, clarity. Type must be legible. But there is more to it than that. Like handwriting, typefaces reflect certain characteristics, such as refinement, dignity, boldness, or strength. Properly used, the typefaces can convey the feeling or mood of a message. The message may be warm, brisk, dignified, modern, or old-fashioned—whatever is needed to emphasize or suggest the thoughts may be expressed in the copy.

Printers have also learned to use type to attract the reader's attention. The use of large, bold faces is one of the more effective ways of stopping the eye. But large, bold type is difficult to read. It should be limited to a few words of copy, and it should be followed by small, legible faces that invite reading.

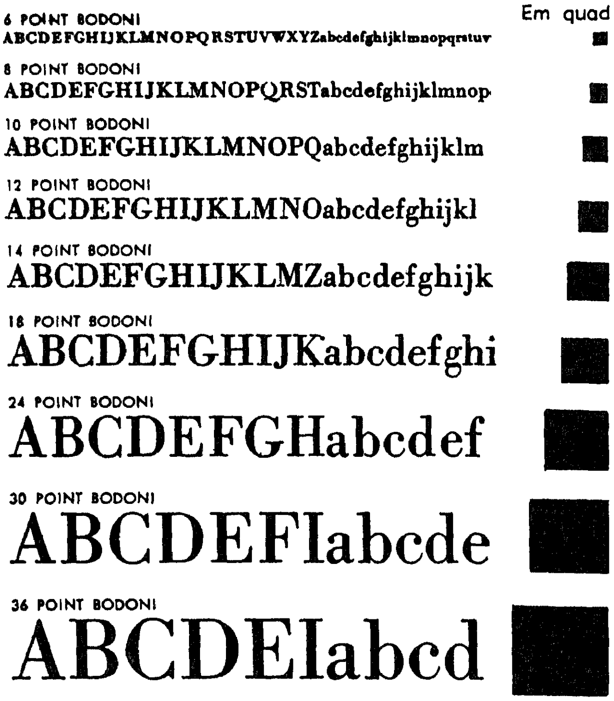
Resemblances and Differences

There are thousands of typefaces. Learning to identify them is like learning to identify ships or aircraft—each has its own distinct characteristics.

The first distinction to be made is between capital letters and small letters. Capital letters are usually called caps or uppercase; small letters are always called lowercase.

Type is further classified according to its size and the style of letter that it carries. Type comes in various sizes. The usual distinction is between big letters (called display or headline type) and the small sizes (called body or text type). However, printer's measurements identify type a great deal more closely than that. Printer's measurements are based on the point system. The point is approximately 1/72 of an inch long. When you hear someone say 8- or 12-point type, that simply means that the body of the type measures 1/9 or 1/6 of an inch from top to bottom. Of course, the typeface itself is seldom as large as the body, because a small shoulder or ledge is left below the letter on most type.

Type sizes range from 3- to 120-point, but the sizes shown in figure 2-41 are those most commonly used. You will notice that the faces shown in the illustration are exactly alike in design; they vary only in size. The classification



45.207.1

Figure 2-41.—A typeface is classified according to its style and size. Shown here is a type style in various sizes.

of different sizes of the same typeface is known as a type series.

Typefaces that are similar though not exactly alike in design are generally grouped in another classification called families. Each family has a name and certain basic family resemblances. Some families include dozens of typefaces—each different in some way, yet each having general characteristics that unmistakably identify it as a member of a particular family.

Take the Bodoni type shown in figure 2-42 for example. All Bodoni type is made up of a combination of thick and thin lines; yet all Bodoni typefaces are not alike. The thickness of the heavy lines varies. There is a light face called Bodoni Book; the regular face, called simply Bodoni; a heavier face, called Bodoni Bold; and a very fat face, called Ultra-Bodoni. There are also condensed faces of corresponding thickness of line, but of narrow width. Then there are expanded faces, again of corresponding thickness, but stretched to extra width. Some families have literally scores of different faces.

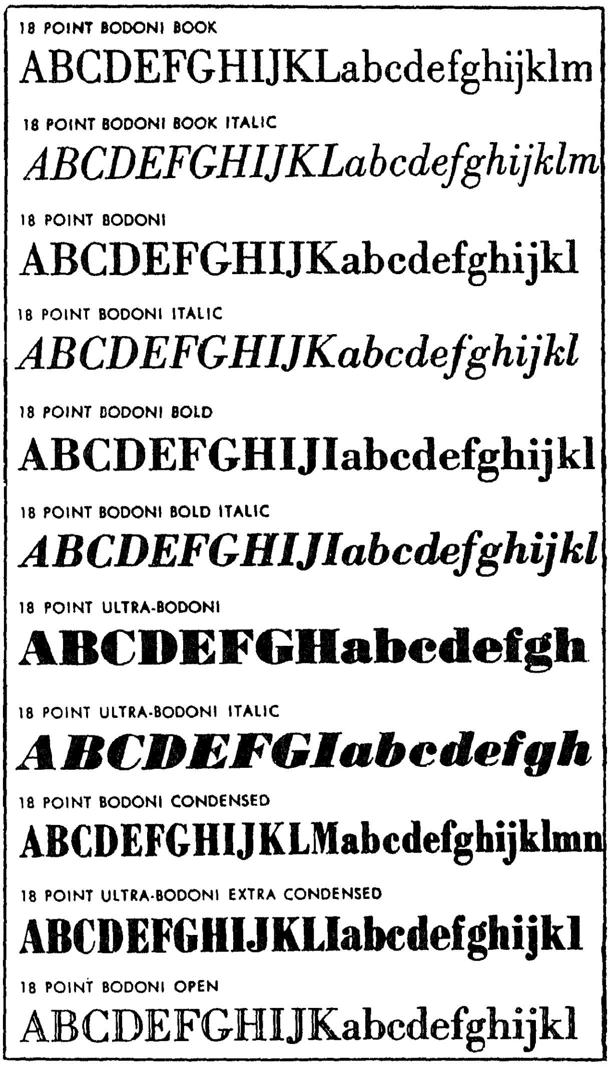


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Figure 2-42.—Some typefaces from the Bodoni family.

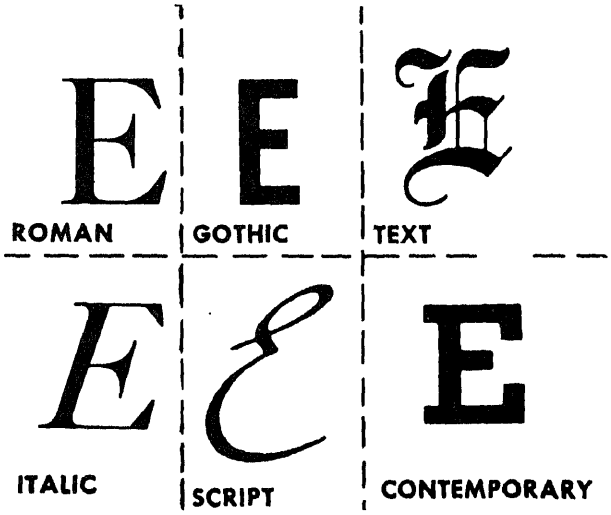
The Six Classes of Type

In addition to being divided into the series and families classifications, type is also divided into the six classes as follows (see fig. 2-43:)

- Roman
- Gothic
- Script
- Text
- Italic
- Contemporary

All authorities do not agree on this grouping, but for practical purposes, this book will discuss typefaces under these six main classes.

ROMAN.—Roman is the type most commonly used for the text of magazines, newspapers, and



45.207.3

Figure 2-43.—The six main classes of type.

books. It is chosen primarily because it is easy to read in the smaller sizes and is, therefore, suitable for lengthy articles.

Roman type is divided into two classifications: modern and old style. The chief difference between modern and old style roman is found in the serifs. (Serifs are the little cross-strokes at the ends of the main lines.) Compare the two letters shown in figure 2-44. Notice that the old style letter has soft, rounded, serifs, while the modern letter has heavier shadings and thin, clean-cut hairlines. Bodoni is typical of modern roman, and Caslon is a good example of the old style faces (see fig. 2-45). Roman faces can be used for any kind of work, but printers generally try to avoid mixing the old style faces with the modern.

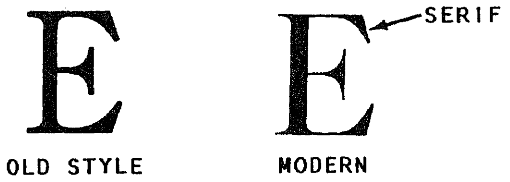


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Figure 2-44.—Comparison of old style and modern roman letters.

BINNEY Old Style
BODONI Bold
BODONI Book
BODONI Bodoni
CASLON, True-Cut
CASLON Old Style
CASLON Bold
CASLON No. 113, Condensed
CASLON Bold Condensed
CASLON Caslon
CENTURY Expanded
CENTURY Expanded Bold
CENTURY Schoolbook
CENTURY Schoolbook
CHELTENHAM Cheltenham
CHELTENHAM Bold Extra Condensed
CHELTENHAM Bold
CHELTENHAM Old Style
CHELTENHAM Wide
CLOISTER Bold Condensed
CLOISTER Oldstyle
CLOISTER Bold
ENGRAVERS BODONI
ENGRAVERS BOLD
FAIRFIELD Fairfield
FORUM TITLE

45.207.5

Figure 2-45.—A few of the roman typefaces.

CONDENSED TITLE GOTHIC NO. 11
BANK GOTHIC CONDENSED BOLD
FRANKLIN Gothic Extra Condensed
POSTER GOTHIC
FRANKLIN Gothic Condensed
RAILROAD GOTHIC
BANK GOTHIC CONDENSED MEDIUM
NEWS Gothic
GOTHIC NO. 520 TO 526
LINING Gothic No. 545
ALTERNATE Gothic No. 1
ALTERNATE Gothic No. 2
ALTERNATE Gothic No. 3
NEWS Gothic Extra Condensed
SANS Serif Bold
COPPERPLATE GOTHIC BOLD NO. 132
GOTHIC No. 544
NEWS Gothic Condensed
GOTHIC No. 3 Gothic No. 3
COPPERPLATE GOTHIC NO. 342, HEAVY
LINING PLATE GOTHIC, HEAVY
COPPERPLATE GOTHIC CONDENSED NO. 129, HEAVY
GOTHIC No. 32 (LIGHT COPPERPLATE)
GOTHIC No. 31 (BOLD COPPERPLATE)
GOTHIC NO. 521, CONDENSED
GOTHIC Condensed No. 49
COPPERPLATE GOTHIC EXTENDED
COPPERPLATE GOTHIC CONDENSED NO. 343, HEAVY
GOTHIC No. 6 Gothic No. 6

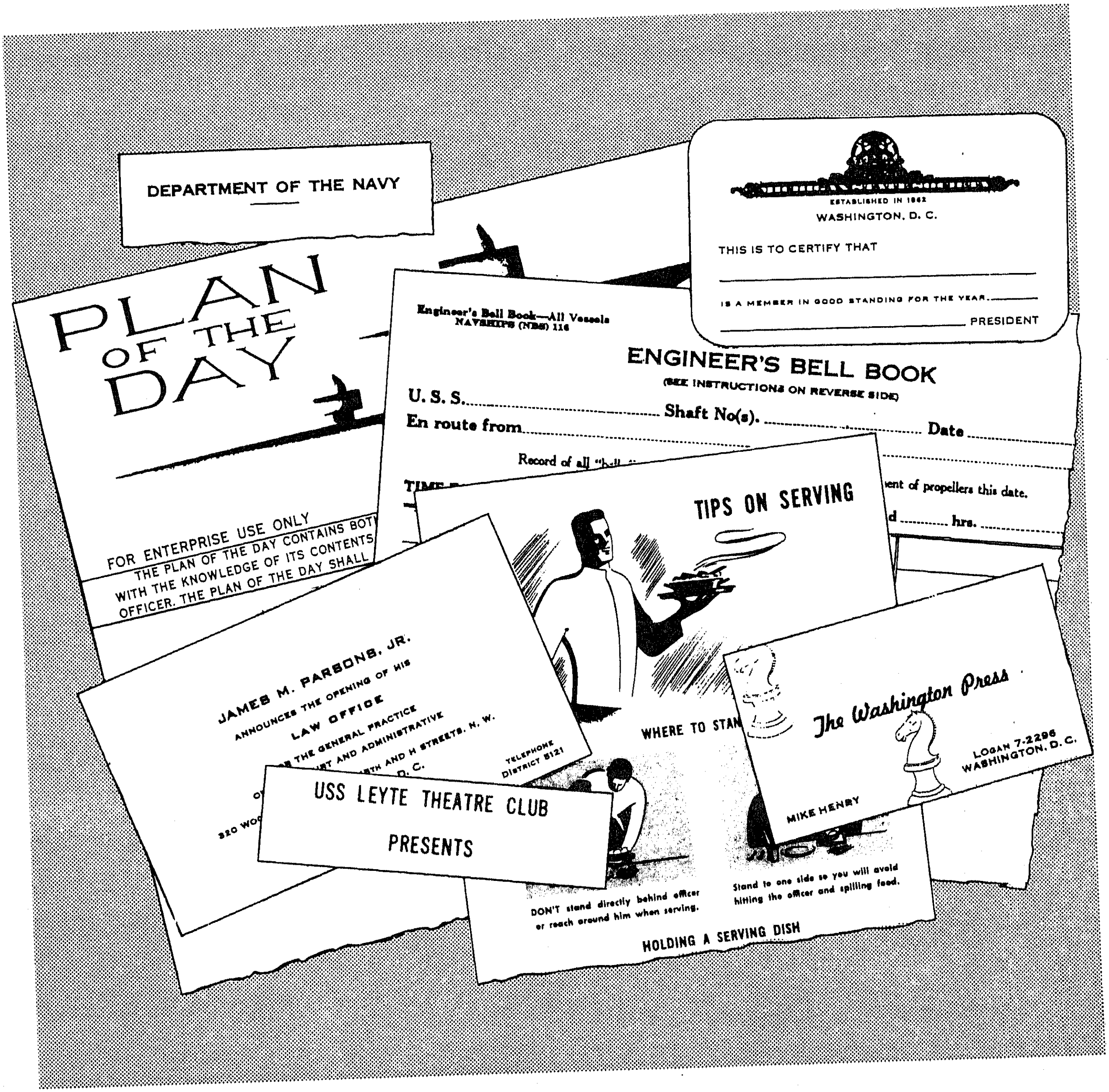
45.207.6

Figure 2-46.—A few gothic typefaces. Alternate and Copperplate Gothics have wide use in standard Navy forms.

GOTHIC.—Study the difference between the roman letter shown in figure 2-45 and the gothic letter shown in figure 2-46. Notice that where the roman letter is composed of a series of thick and thin lines, the gothic letter is constructed of lines of even weight. The gothic letter has no serifs—it is perfectly plain, and it might even be called a block letter. Figure 2-46 shows some of the gothic types. The sans serif included in the illustration is an up-to-date style of gothic. However, because of its modern design, it is generally grouped not with the gothics but with the contemporary typefaces.

As you will see in figures 2-46 and 2-47, there are several kinds of gothic typefaces. Each has its place in modern printing. Copperplate Gothic, for example, is generally used for letterheads, envelopes, cards, announcements, and many kinds of office forms.

News Gothic is another serviceable face. It may be used as a body type, and it is equally serviceable for titles and headings. Franklin Gothic, Alternate Gothic, and Poster Gothic are used chiefly for display work. They are very popular for posters and headings.



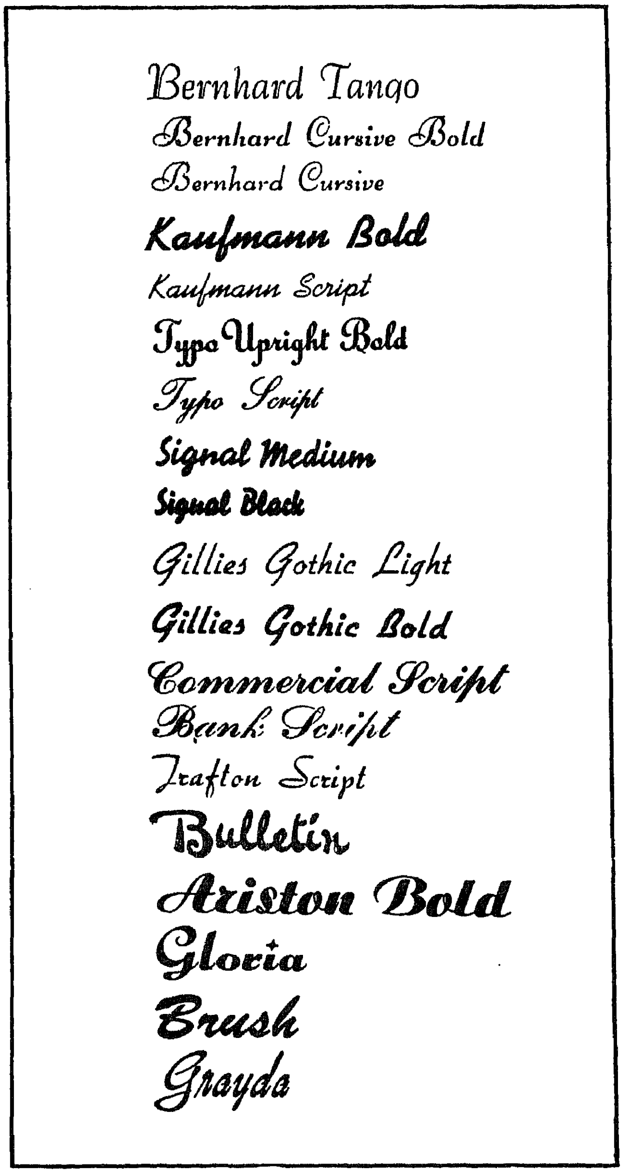
45.207.7

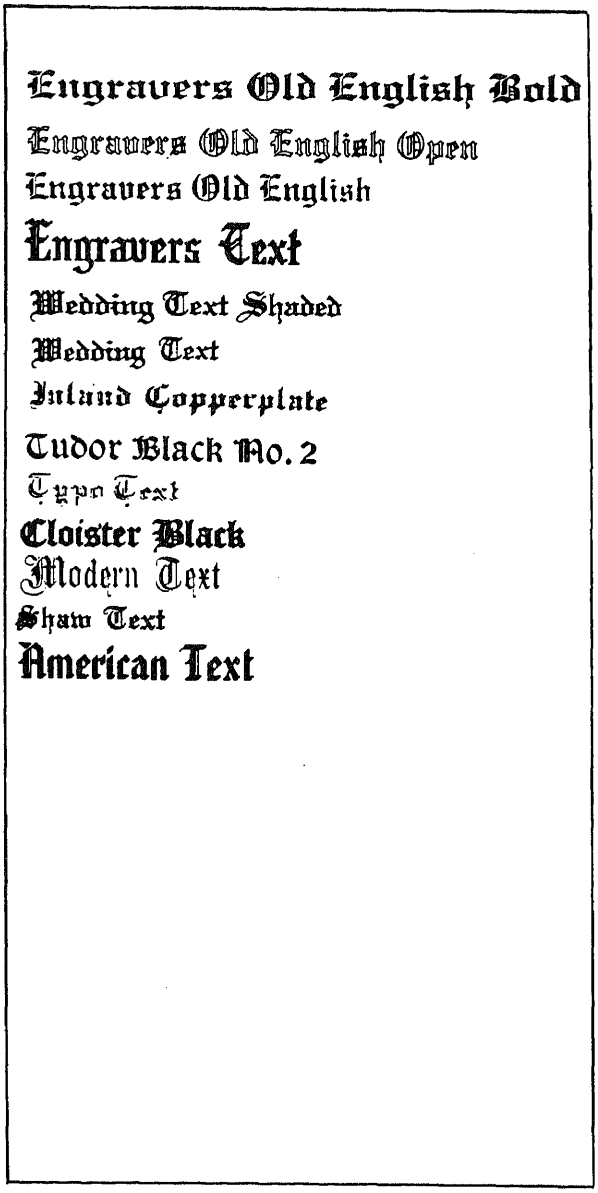
Figure 2-47.—Some uses of gothic typefaces.

SCRIPT.—Script and cursive typefaces are generally grouped together (see fig. 2-48). Scripts have little connective links or kerns, and when the letters are combined, the kerns give the letters the appearance of handwriting. Cursive letters do not have these kerns. Actually the scripts are an imitation of the old Spencerian handwriting, and the cursives are patterned after old-fashioned hand-lettering.

Script faces are extremely suitable for announcements and invitations. They may also be used to impart an air of elegance and charm to display work. Notice that some of the typefaces shown are contemporary styles used in modern display work.

TEXT.—Samples of text typefaces are shown in figure 2-49. You might know this type simply as "Old English." Text was one of the first type styles used. In fact, Gutenberg worked almost exclusively with this style of type. Although it is still used, text is usually limited to a few lines of copy. You should save it for something religious or


Bernhard Tango
Bernhard Cursive Bold
Bernhard Cursive
Kaufmann Bold
Kaufmann Script
Typo Upright Bold
Typo Script
Signal Medium
Signal Black
Gillies Gothic Light
Gillies Gothic Bold
Commercial Script
Bank Script
Trafton Script
Bulletin
Ariston Bold
Gloria
Brush
Grayda


Engravers Old English Bold
Engravers Old English Open
Engravers Old English
Engravers Text
Wedding Text Shaded
Wedding Text
Inland Copperplate
Tudor Black No. 2
Typo Text
Cloister Black
Modern Text
Shaw Text
American Text

formal, such as prayer books, programs, and invitations.

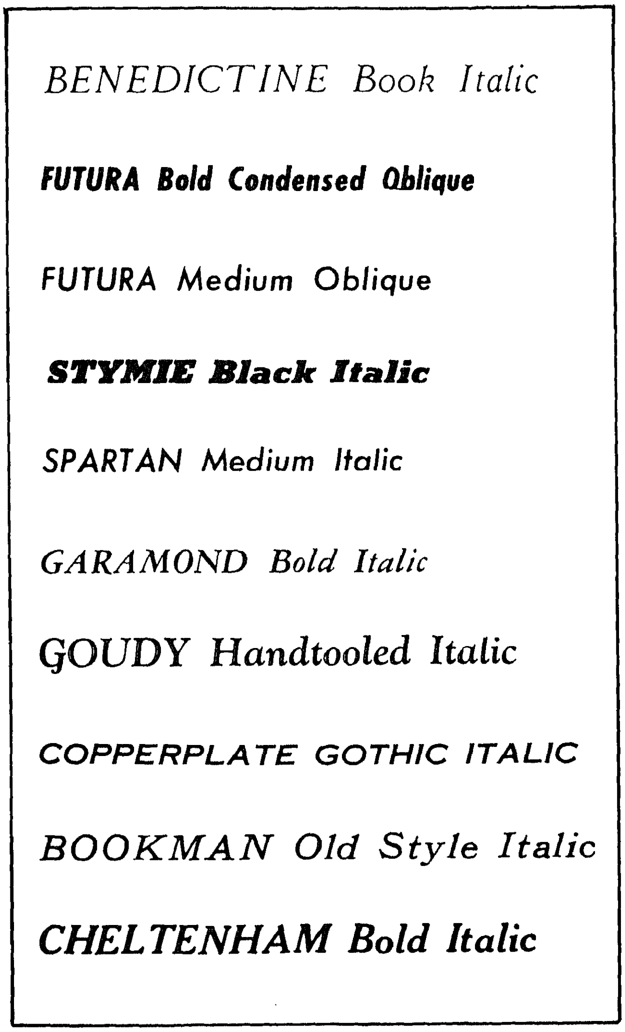
ITALICS.—Italics are slanting letters like those shown in figure 2-50. Italics are made to match almost every roman, gothic, and contemporary type style in use today. They are used in text matter to show emphasis and in display work to create contrast and to add interest to the job. Although italics were originally used for the text, they were rather hard to read in lengthy articles. They have been used less and less for this purpose, and today they are used rather sparingly.

Swash letters are similar to italics, but they are embellished by additional swirls and curves, known as swashes. You can sometimes use them with italics to dress up a page that otherwise might be bare and unattractive.

CONTEMPORARY.—Contemporary faces are modern faces. Many of these modern faces are fads—their style and usefulness will be short-lived. However, a few serviceable typefaces will take their places alongside the old standbys we've been discussing.

Leading the contemporary field are two distinct styles: the sans serif and the square serif. Sans serif type, as you have already seen, is actually a kind of gothic type. Sans serif type has the same even strokes as the gothic; and, like the gothic, it has no serifs. But unlike its gothic ancestors, it has such perfect geometric proportions that it is usually included with the contemporary typefaces.

Study the Futura typefaces (fig. 2-51) for a moment. Notice that the letters seem to be constructed from squares, rectangles, and other



BENEDICTINE Book Italic

FUTURA Bold Condensed Oblique

FUTURA Medium Oblique

STYMIE Black Italic

SPARTAN Medium Italic

GARAMOND Bold Italic

GOUDY Handtooled Italic

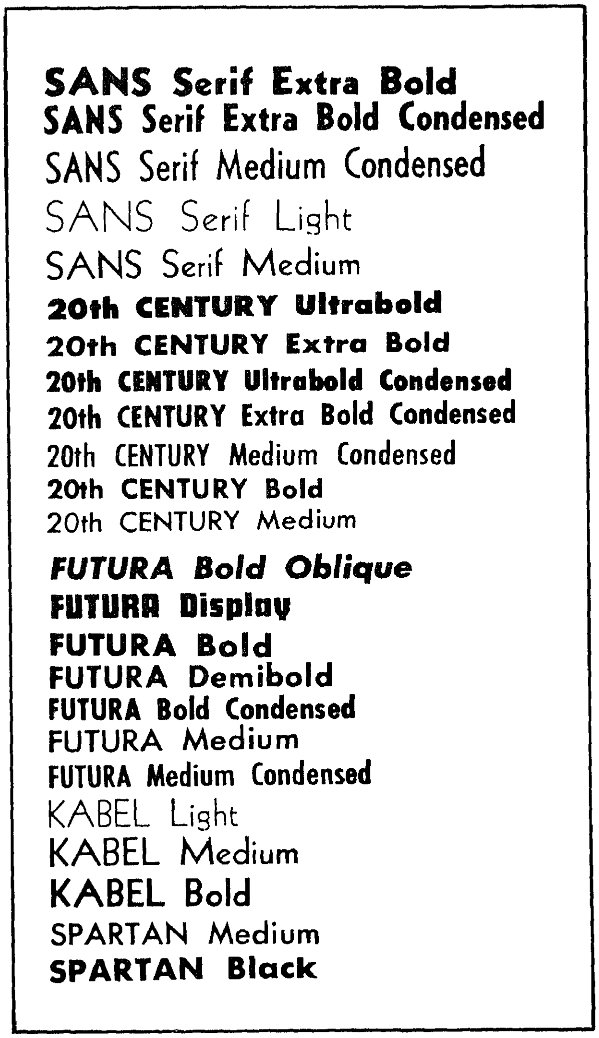
COPPERPLATE GOTHIC ITALIC

BOOKMAN Old Style Italic

CHELTENHAM Bold Italic

45.207.10

Figure 2-50.—Italics are made to match many of the typefaces in use today.



SANS Serif Extra Bold
SANS Serif Extra Bold Condensed
SANS Serif Medium Condensed
SANS Serif Light
SANS Serif Medium
20th CENTURY Ultrabold
20th CENTURY Extra Bold
20th CENTURY Ultrabold Condensed
20th CENTURY Extra Bold Condensed
20th CENTURY Medium Condensed
20th CENTURY Bold
20th CENTURY Medium
FUTURA Bold Oblique
FUTURA Display
FUTURA Bold
FUTURA Demibold
FUTURA Bold Condensed
FUTURA Medium
FUTURA Medium Condensed
KABEL Light
KABEL Medium
KABEL Bold
SPARTAN Medium
SPARTAN Black

45.207.11

Figure 2-51.—Sans serif typefaces.

geometric forms. Futura is the last word in simplicity, and yet it is one of the more serviceable modern typefaces printers have at their disposal. It can be used almost anywhere.

Square-serif typefaces (fig. 2-52) are similar to sans serif typefaces. They have the same even strokes and the same perfect geometric proportions. However, square-serif typefaces have serifs, of course, and those serifs are square. Square-serif type originated in Europe shortly after the sans serif faces made their appearance. It became popular in the United States in the early thirties. Some people think it is an offspring of the old Egyptian alphabet. Others believe it was inspired by typewriter type that was widely employed by advertisers of that period. Stymie is a typical example of this type.

Contemporary display is a classification that includes the hundreds of modern typefaces used in display work today. There are so many of them that listing them would be difficult. There are a number of scripts and italics, for example, which can be identified by their streamlined appearance. The Kaufman shown in figure 2-48 is one of these modern scripts. Others include Brush and Gilles Gothic.

There are also a number of tall, condensed types, such as Onyx and Valiant (see fig. 2-53.) Then there are wide, bold faces, such as Venus Extrabold Extended. And there are medium faces, such as Lydian and Studio. These types are used chiefly for display composition.

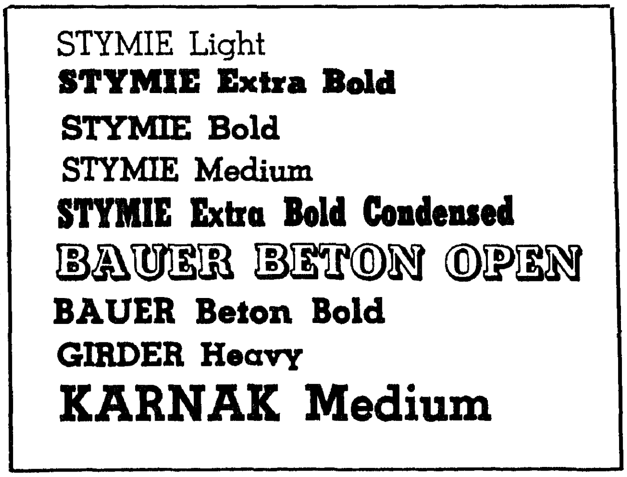


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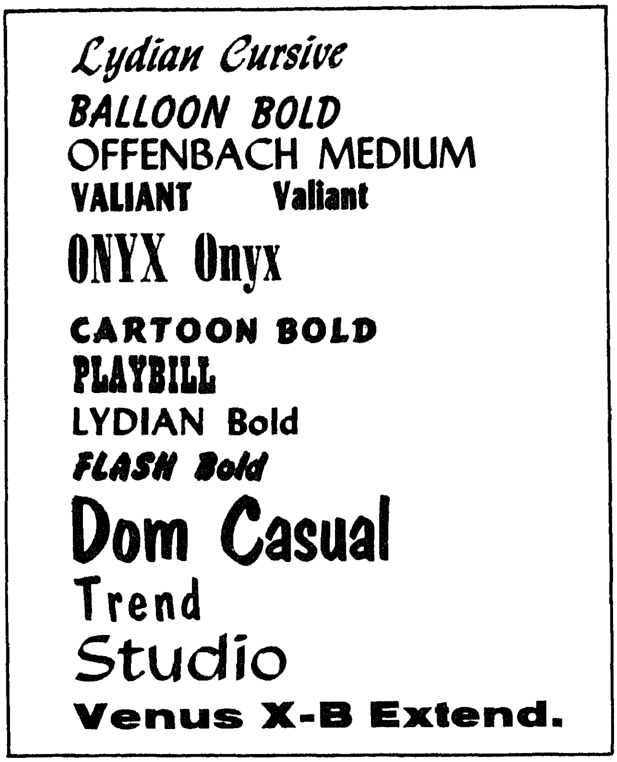
Figure 2-52.—Square-serif typefaces.



45.207.13

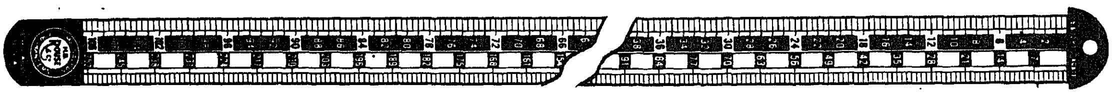
Figure 2-53.—Contemporary display typefaces.

Legibility

You have already seen that type must be legible to be read. A newspaper printed in Old English or in some equally illegible type would probably discourage half of its readers—or at least, wear them out. Many of the early typefaces have been abandoned because they were too hard to read. The trend today is toward legibility.

TYPE STYLE AND SIZE.—There are certain factors to help you attain legibility, just as there are factors to hinder you. The style of letter you use is important—the simpler the style, the easier the reading. Open, clean-cut letters with plain serifs are best. The serifs lend unity to the words, binding them together for easy reading.

The agreement of the type style with the subject matter of the copy is less important in the selection of body typefaces. In selecting a typeface for the text or body of a job, you simply need to select a style that is legible and pleasing in design.



57.18

Figure 2-54.—The line gauge.

CHANGE OF COMMAND

C H A N G E O F C O M M A N D

45.207.14

Figure 2-55.—Letterspacing of large display typefaces increases legibility.

The size of the type also affects legibility. If you have ever tried to read the small print on a contract, you know that the smaller sizes of some typefaces are almost impossible to read. Eight- to ten-point type is considered to be the most legible. Larger or smaller sizes are usually more difficult to read.

LENGTH OF LINE.—The length of the line also affects the ease with which the material can be read. You will find that 2- to 3-inch columns are generally used for 8-point type and that 2- to 5-inch columns are used for 10-point type. The length of the line should be reduced or increased in proportion to the size of the type used.

The length of lines is always measured in picas—another printer's measure. The pica is equal to 12 points, and there are approximately 6 picas to the inch. Therefore a line of type 3 inches long is said to be 18 picas long. Printers use a ruler called a line gauge (see fig. 2-54) to measure lengths. It is marked in inches on one side and in picas on the other so you can measure dimensions either way.

SPACING BETWEEN LINES.—The amount of spacing between the lines is another factor that affects legibility. In general, more space should be used between long lines than between short lines. Certain typefaces also call for wider spacing between the lines than do others.

The space between the lines is called *leading* (pronounced led-ding). The term *leading* is derived from the use of thin metal strips to separate the lines of hand-set type. The space between the lines is measured in points.

SPACING BETWEEN WORDS.—Proper spacing between words is another key factor in attaining legibility. You must use sufficient spacing between the words to prevent them from running together.

SPACING BETWEEN LETTERS.—Certain typefaces, primarily large display faces, are more legible if space is added between the individual characters. This technique is called *letterspacing*. In figure 2-55, you can see how letterspacing increases legibility.

ADDITIONAL LEGIBILITY FACTORS.—Other factors that affect legibility are listed below:

- Lines set in caps and lowercase letters are more legible than lines set in all caps. Words set in all caps in a script or text typeface are almost illegible. (See fig. 2-56.)

Change of Command Ceremony

CHANGE OF COMMAND CEREMONY

45.207.15

Figure 2-56.—Script and text type styles set in caps lose legibility.

- Old style roman faces are more readable and are easier on the eyes than are modern roman faces.

- Medium faces are more legible than either condensed or expanded faces, particularly in the smaller sizes.

- Expanded faces are more readable in text than condensed faces are, but they take up more room and sometimes are not worth the difference.

- Condensed faces are more practical for display work than expanded typefaces are, because more characters can be placed in a line and the type is large enough that there is no appreciable loss of legibility.

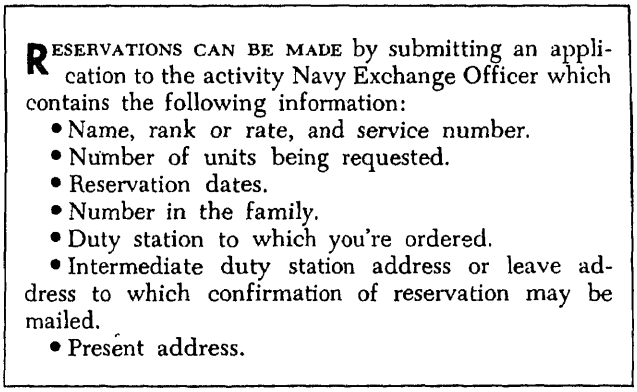
- Ample blank space (margins) makes a page more readable.

- Paragraphs and indentions help to break up the page and thus increase legibility.

- Different typefaces should be mixed sparingly; it is better to use different sizes of the same typeface or a different type series within the family than to mix a variety of type families.

ORNAMENTS AND BORDERS

Initial letters (see fig. 2-57) are large, capital letters that are sometimes used at the beginning of a paragraph to dress up the page. They come in all sorts of styles.



RESERVATIONS CAN BE MADE by submitting an application to the activity Navy Exchange Officer which contains the following information:

- Name, rank or rate, and service number.
- Number of units being requested.
- Reservation dates.
- Number in the family.
- Duty station to which you're ordered.
- Intermediate duty station address or leave address to which confirmation of reservation may be mailed.
- Present address.

57.693

Figure 2-57.—Initial letters, small caps, and ornaments are

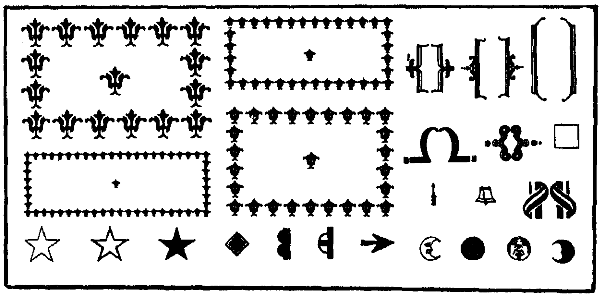
When an initial letter is used, the remainder of the word is usually capitalized. You may use either regular capital letters or slightly smaller capitals of the same style of type. These small capitals are called small caps. Small caps may also be used instead of italics to emphasize words or phrases in the text of books and manuals.

Ornaments (see fig. 2-58), such as stars (dingbats) and dots (bullets), are used to add interest and beauty to a job. When you use ornaments, you should always select something that goes well with the style of type that you are using. Above all, don't overdo it. Fancy types and decorations should be used only if they make the word more effective. Decoration-just-for-decoration's-sake was abandoned at the turn of the century in favor of simple harmony and balance.

Borders should be selected with the same care that is used in selecting a typeface, because the same general principles of typography apply. You will find that certain borders go with certain typefaces, just as certain typefaces go together. One type of border, called a scotch rule, is made up of one heavy line and one thin line. The scotch rule is ideally used with the Bodoni typeface because the elements are the same—a heavy and a thin line.

The various lines used within a printed page are called rules. Rules may be used to separate sections of a page, to guide the reader's eye, or to serve as writing lines.

A rule primarily used for a writing line is called a hairline rule. A medium rule is



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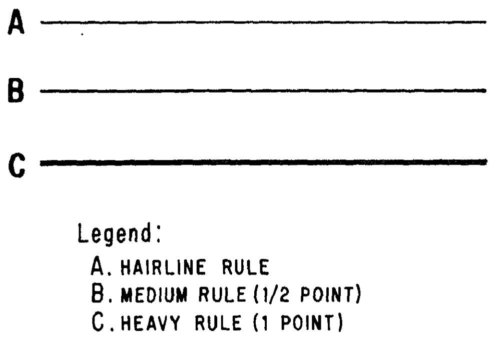

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Figure 2-59.—Comparison of rule weights.

used for dividing sections of a form. A heavy rule is used to add special emphasis to a section and is generally used for the first and last lines of a form. Figure 2-59 illustrates the various rule sizes, which are referred to as line weights.

The selection of rules is important to the overall legibility of your work. Too many rules, or rules that are too heavy, tend to make a printed page or form difficult to read.

SUMMARY

Work sent to your shop that requires no changes or corrections is termed *camera-ready*.

New or original jobs could require several steps of job planning and copy preparation. These steps may include the following: preparing a layout, making a dummy, selecting type, composing the type matter, ruling, and preparing the artwork. The size and complexity of the job will determine the necessary steps.

The layout shows the arrangement of the type matter and the position of the illustrations. It is the first step taken in planning a job.

A dummy is generally prepared for multiple page booklets. It is in the form of blank pages ruled to scale with markings that indicate type sizes and styles, rule weights, and other pertinent information.

The selection of the type size and style is important to each job. Legibility is the first concern when you make a type selection.

Type styles are grouped into six classifications: roman, gothic, script, text, italic, and contemporary.

There are many factors that determine the legibility of a printed page. The size and style of the type, the length of the lines, and the amount of spacing between the words and lines are all legibility factors.

The selection of rules, borders, and ornaments is as important to a job as selection of type is. Certain rules, borders, and ornaments go with certain typefaces, just as certain typefaces go together.

CHAPTER 3

COLD TYPE COMPOSITION

A designated section of this chapter contains information required for LI1 and LIC candidates only. This section will be prefaced with For LI1 and LIC Candidates Only. LI3 and LI2 candidates DO NOT have to read the designated section. However, junior LIs serving as LPOs may find the information of interest.

Material that is to be printed is generally referred to as "copy." Copy that is produced by methods that do not include the use of metal type or slugs is known as cold type copy or cold type composition. Phototypeset obtained from the Varityper Comp/Edit system, or the Headliner and typewritten copy from an IBM Selectric typewriter are methods used to produce cold type composition.

This manual was printed by offset lithography from copy that was composed on an electronic composer. After this copy was proofread and corrected, the term "reproduction proof" was applied to the copy. Then the copy was photographed to provide the negatives from which the lithographic plates were obtained.

Photo-offset printing is done from flat, metal plates rather than from raised surfaces. Since these plates are produced from negatives, the copy may consist of reproduction proofs pulled from either type, clippings, cold type composition, or phototypeset copy. Any of these media may be used as long as the copy is sharp and of a color that will photograph well, such as black or red.

In this chapter, you will learn the operating features of the most prevalent cold type composing equipment in use in the Navy today. You will also see how the copy is prepared and corrected before it is photographed.

COPY PLACEMENT

As a lithographer, you will be working with placing printed work/copy into designated areas. The areas may be determined by the size or shape of the paper or other items to be arranged on the pages, such as figures, illustrations, or borders. The process of putting the copy into these boundaries is known as copy placement.

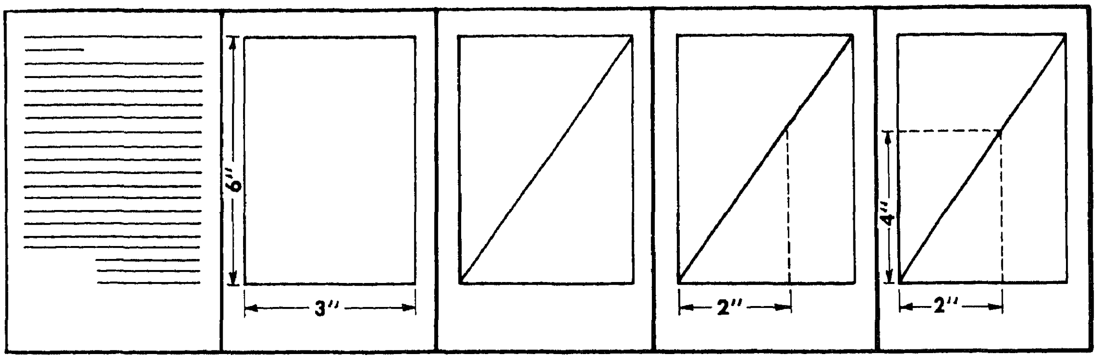
COPYFITTING

It is sometimes necessary to photograph cold type composition on a smaller scale so that it will fit into the space allotted. This reduction is commonly referred to as copyfitting. Typewritten copy is frequently reduced by one third or one half of its original size. Copy that is reduced increases and makes the image more detailed; while copy that is enlarged loses detail and sharpness.

There are many other methods of copyfitting. Some operators use plastic scales that fit against the typed lines; others use copyfitting charts showing the number of characters of each size of type that will go into 1 pica of space and so on. But most of these are simply variations of the process just described.

SCALING

If you find that the copy will not fit into the space allotted to it, you may select



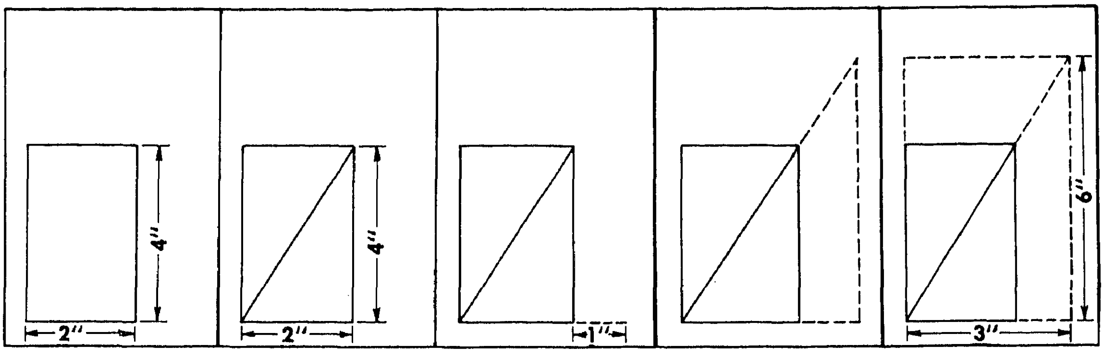
SUPPOSE YOU HAVE COPY 3 IN. WIDE AND 6 IN. DEEP WHICH YOU MUST REDUCE TO FIT INTO A 2 IN. COLUMN . . .

. . . . FIRST, DRAW A RECTANGLE THE EXACT SIZE OF THE COPY . . .

. . . . THEN DRAW A DIAGONAL FROM THE LOWER LEFT CORNER TO THE RIGHT UPPER CORNER . . .

. . . MEASURE OFF 2 IN. ON YOUR BOTTOM LINE AND DRAW A DOTTED LINE AT A RIGHT ANGLE FROM IT TO THE DIAGONAL LINE.

COMPLETE THE RECTANGLE AND MEASURE THE SPACE. IT IS THE AREA YOUR COPY WILL OCCUPY WHEN REDUCED.



SUPPOSE THAT YOU WISH TO TYPE THE COPY ONE-HALF LARGER SO THAT IT CAN BE REDUCED WHEN PHOTOGRAPHED . . .

. . TO FIND YOUR TYPING DIMENSIONS, DRAW A RECTANGLE 2 IN. X 4 IN. AND RUN A DIAGONAL ACROSS IT. . . .

. . . EXTEND THE BASE 1 IN. ($\frac{1}{2}$ OF 2 IN.):

. . . DRAW THE DOTTED LINE AT A RIGHT ANGLE TO THE BASE LINE AS BEFORE, AND EXTEND THE DIAGONAL LINE TO MEET IT . . .

THEN COMPLETE THE RECTANGLE AND YOU WILL FIND YOUR TYPING AREA.

57.15

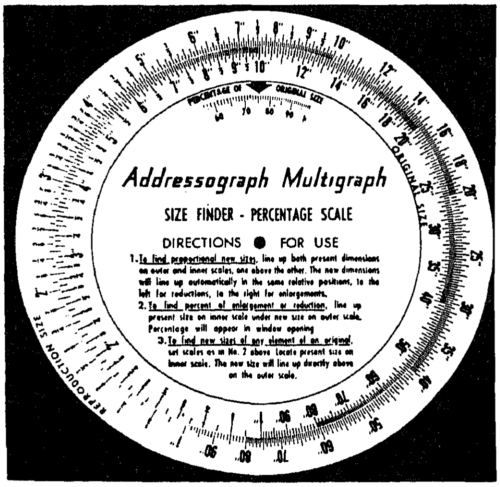
Figure 3-1.—Methods of scaling for enlargement and reduction.

a smaller typeface, vary the spacing, or have the copy reduced. Figure 3-1 shows how to plan copy proportions when reductions are needed.

When the camera reduces the width of a block of type, it also reduces its height. Therefore, you must plan your work in the proper proportions so that the work will come down to the correct dimensions when the copy is reduced. To find the typing dimensions, you can use a simple plan for proportionate reduction or enlargement. This plan is called "scaling." Figure 3-1 shows how to scale work for enlargement or reduction. This same system can be used for fitting photographs and artwork into the job because they also have width and height.

SCALING WHEEL

A scaling wheel may be used to scale copy or art. The illustration in figure 3-2 shows a scaling



DIRECTIONS ● FOR USE

1. To find proportional new sizes, line up both present dimensions on outer and inner scales, one above the other. The new dimensions will line up automatically in the same relative positions, to the left for reductions, to the right for enlargements.
2. To find percent of enlargement or reduction, line up present size on inner scale under new size on outer scale. Percentage will appear in window opening
3. To find new sizes of any element of an original, set scales as in No. 2 above. Locate present size on inner scale. The new size will line up directly above on the outer scale.

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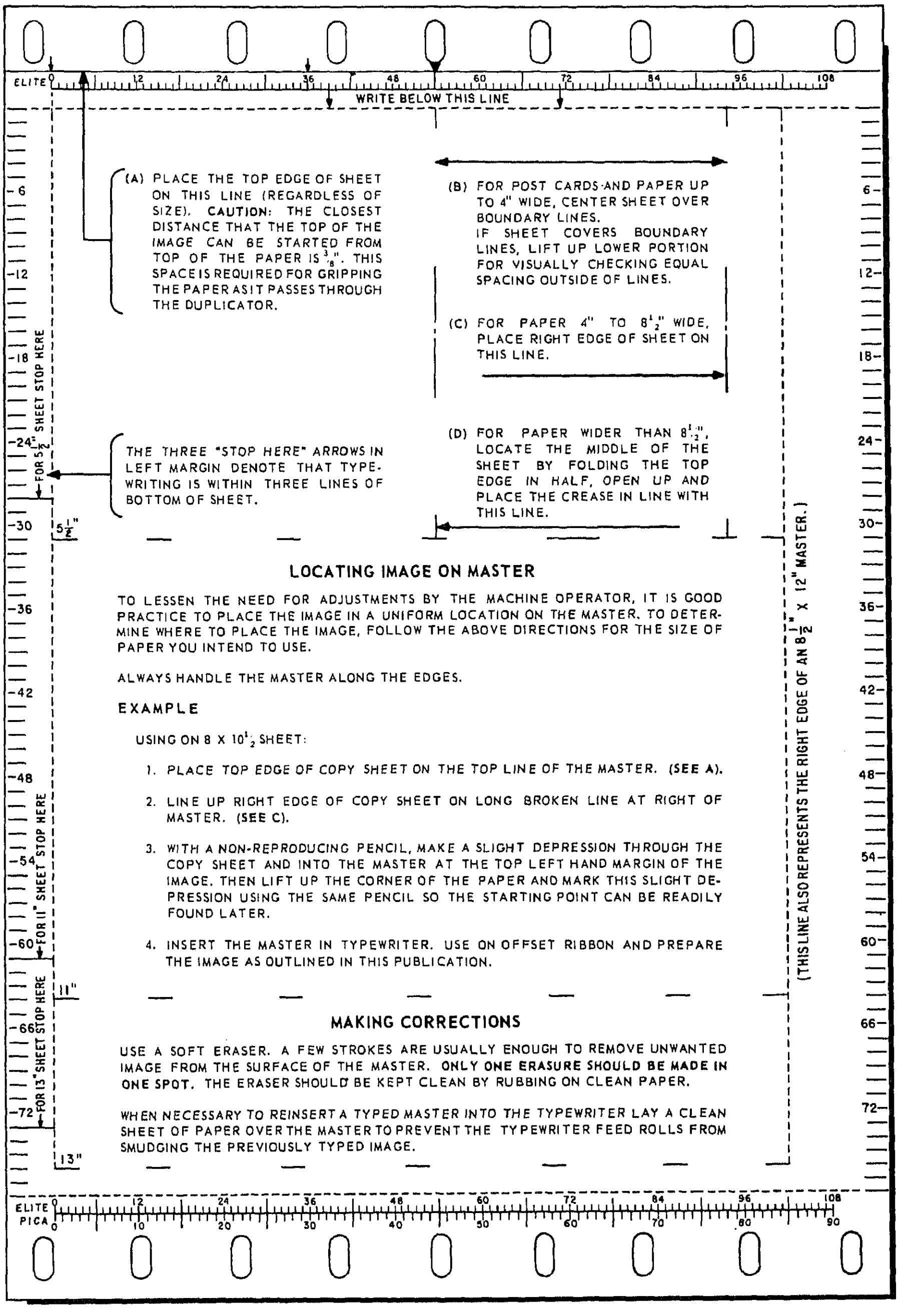
Figure 3-2.—Scaling wheel.


ELITE
PICA
WRITE BELOW THIS LINE
FOR 5½" SHEET STOP HERE
FOR 11" SHEET STOP HERE
FOR 13" SHEET STOP HERE
5½"
11"
13"
(THIS LINE ALSO REPRESENTS THE RIGHT EDGE OF AN 8½" X 12" MASTER.)

(A) PLACE THE TOP EDGE OF SHEET ON THIS LINE (REGARDLESS OF SIZE). **CAUTION:** THE CLOSEST DISTANCE THAT THE TOP OF THE IMAGE CAN BE STARTED FROM TOP OF THE PAPER IS 3/8". THIS SPACE IS REQUIRED FOR GRIPPING THE PAPER AS IT PASSES THROUGH THE DUPLICATOR.

(B) FOR POST CARDS AND PAPER UP TO 4" WIDE, CENTER SHEET OVER BOUNDARY LINES.
IF SHEET COVERS BOUNDARY LINES, LIFT UP LOWER PORTION FOR VISUALLY CHECKING EQUAL SPACING OUTSIDE OF LINES.

(C) FOR PAPER 4" TO 8½" WIDE, PLACE RIGHT EDGE OF SHEET ON THIS LINE.

THE THREE "STOP HERE" ARROWS IN LEFT MARGIN DENOTE THAT TYPEWRITING IS WITHIN THREE LINES OF BOTTOM OF SHEET.

(D) FOR PAPER WIDER THAN 8½", LOCATE THE MIDDLE OF THE SHEET BY FOLDING THE TOP EDGE IN HALF, OPEN UP AND PLACE THE CREASE IN LINE WITH THIS LINE.

LOCATING IMAGE ON MASTER

TO LESSEN THE NEED FOR ADJUSTMENTS BY THE MACHINE OPERATOR, IT IS GOOD PRACTICE TO PLACE THE IMAGE IN A UNIFORM LOCATION ON THE MASTER. TO DETERMINE WHERE TO PLACE THE IMAGE, FOLLOW THE ABOVE DIRECTIONS FOR THE SIZE OF PAPER YOU INTEND TO USE.

ALWAYS HANDLE THE MASTER ALONG THE EDGES.

EXAMPLE

USING ON 8 X 10½ SHEET:

1. PLACE TOP EDGE OF COPY SHEET ON THE TOP LINE OF THE MASTER. (SEE A).
2. LINE UP RIGHT EDGE OF COPY SHEET ON LONG BROKEN LINE AT RIGHT OF MASTER. (SEE C).
3. WITH A NON-REPRODUCING PENCIL, MAKE A SLIGHT DEPRESSION THROUGH THE COPY SHEET AND INTO THE MASTER AT THE TOP LEFT HAND MARGIN OF THE IMAGE. THEN LIFT UP THE CORNER OF THE PAPER AND MARK THIS SLIGHT DEPRESSION USING THE SAME PENCIL SO THE STARTING POINT CAN BE READILY FOUND LATER.
4. INSERT THE MASTER IN TYPEWRITER. USE ON OFFSET RIBBON AND PREPARE THE IMAGE AS OUTLINED IN THIS PUBLICATION.

MAKING CORRECTIONS

USE A SOFT ERASER. A FEW STROKES ARE USUALLY ENOUGH TO REMOVE UNWANTED IMAGE FROM THE SURFACE OF THE MASTER. **ONLY ONE ERASURE SHOULD BE MADE IN ONE SPOT.** THE ERASER SHOULD BE KEPT CLEAN BY RUBBING ON CLEAN PAPER.

WHEN NECESSARY TO REINSERT A TYPED MASTER INTO THE TYPEWRITER LAY A CLEAN SHEET OF PAPER OVER THE MASTER TO PREVENT THE TYPEWRITER FEED ROLLS FROM SMUDGING THE PREVIOUSLY TYPED IMAGE.

57.695

Figure 3-3.—A direct image master.

wheel commonly used by Navy Lithographers. The scaling wheel consists of two dials joined together so that the inner dial can be turned. For example, if your copy is 5 inches wide and 10 inches deep and you wish to reduce it to 3 inches in width, you can find your new depth by turning the inner dial until the 5 is aligned with the 3 on the outside dial. Then look at 10 on the inside dial. Directly over it on the outer dial you will find the figure 6, which represents the new depth of your copy after reduction.

DIRECT IMAGE PLATES PREPARATION

As a lithographer, you will find that some of your printing jobs will be prepared on direct image masters or plates (see fig. 3-3). A direct image master is a plate on which the image is directly applied, bypassing the use of a photographic process.

Direct image masters come in many different sizes, but they are primarily used on the smaller presses. They are economical for short-run work and will produce satisfactory copies for many of the jobs sent to your shop.

The quality of the copies printed from direct image masters is determined in part by the care taken while they are prepared. A manual typewriter may be used to prepare the direct image masters; however, an electric typewriter or cold type composing machine is preferred. With electric equipment, the typing pressures are better controlled.

A special grease-base ribbon must be used to obtain an image on the master that will stand up through the printing process. In addition to the reproducible ribbon, special reproducible pens and/or pencils must be used if the master is to have a signature or drawing. (Note: Photographs may not ordinarily be reproduced when direct image masters are used.)

When you are working with direct image masters, be sure the composing equipment is clean and in good operating order. Otherwise the grease from the ribbon or oil or grease from other parts of the equipment will smear on the masters and the finished copies will have a poor appearance. Because of their affinity for oil and grease, direct image masters will also accept the natural oils from your fingers and cause smudges to print. To prevent some of the smudges, handle the masters along the edges whenever possible.

To make corrections to direct image masters, you should use a soft, greaseless eraser; to prevent the coated surface of the master from being damaged, use a light, lifting stroke with the eraser. A faint ghost of the original image remaining after an eraser will not reproduce on the finished copies.

Before you start typing on one of these masters, go over it with a piece of cotton to remove any chalkiness from its surface. Taking this extra step will permit the greases to be more successfully accepted by the surface of the master.

MARGINS

Direct image masters have light colored lines printed on them, which serve as margins or guidelines for the typist. These margins will not reproduce when the master is printed. The margins show the relative position of the copy when the job is run on the press sheet. The space between the lines indicating "write below this line" is known as the gripper margin. No copy should be typed in this area because the press grippers overlap the sheet in this space when they clasp the sheet of stock (paper) to pull it through the press. You will learn more about gripper margins in a later chapter.

DRAWING

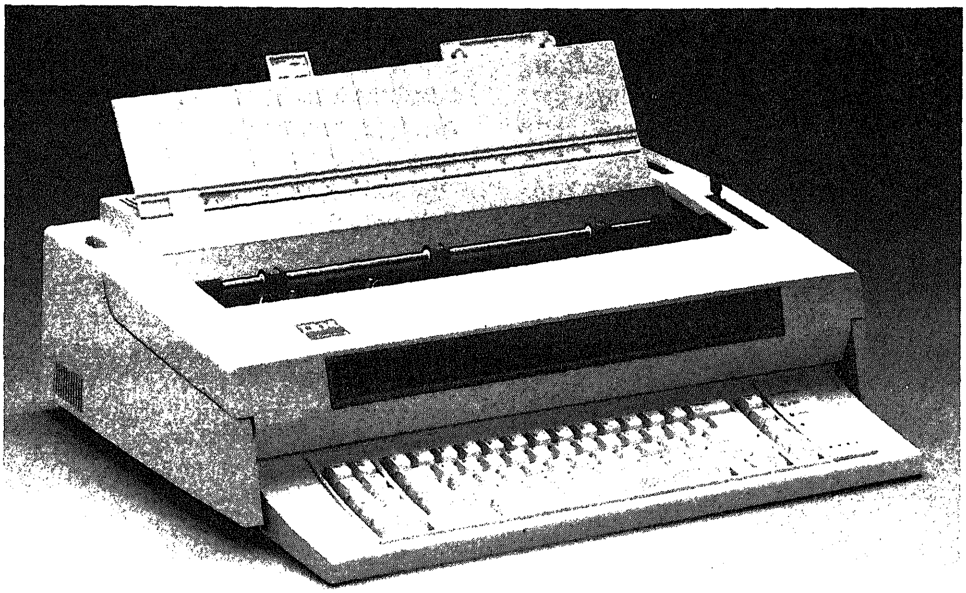
You can draw or letter on direct image masters with crayons, reproducible pencils, grease-base pencils, ball-point pens, or specially prepared inks. When typing and drawing are combined, it is usually best to do the typing first.

COLD TYPE COMPOSITION EQUIPMENT

Because of the various types of equipment available, a lithographer may use many methods for composing copy. As the composer in your shop, you will be using cold type composition equipment to prepare jobs ranging from the most complex such as change of command programs to simple handouts. Therefore, you should become skilled in using cold type composing equipment, whether it's a basic typewriter or a photo/electronic composing machine. In this manual we will discuss some of the most common types of cold type composition machines.

IBM WHEELWRITER

The IBM Wheelwriter typewriter, as shown in figure 3-4, uses the IBM printwheels which are available in many type styles. You can change from one type style to another by removing the printwheel for one type style and replacing it with another in a matter of seconds.



57.372X

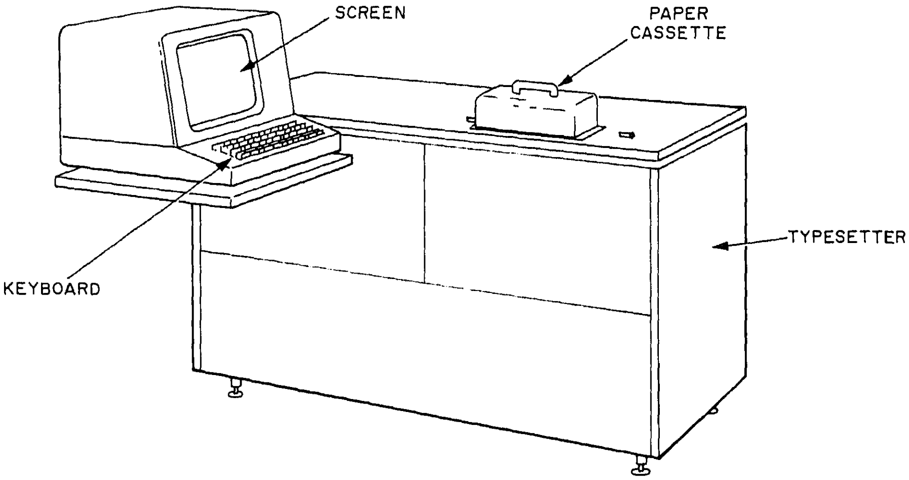
Figure 3-4.—IBM Wheelwriter typewriter.

Although the IBM Wheelwriter typewriter uses standard typewriter spacing, it also has proportional spacing capability. Because it is an "impact printer," IBM Wheelwriter can be used to compose cold type originals either on plain paper or on lithographic direct image masters.

Remember—When you are typing classified materials on the machine, all waste materials that contain a readable image should be handled as classified waste.

VARITYPER COMP/EDIT

Your shop may be equipped with the Varityper Direct Entry Phototypesetting System—a Varityper Comp/Edit (see fig. 3-5). This system



57.373

Figure 3-5.—Varityper Comp/Edit system.

produces high-quality, inexpensive typesetting. From the marked-up rough, the operator types the system's instructions into the Comp/Edit. Then the operator types the copy. From the information typed into the Comp/Edit, a camera-ready galley or page is produced.

The Comp/Edit operator's components consist of the following:

- Keyboard
- Screen
- Typesetter
- Type disc
- Paper cassette

Keyboard

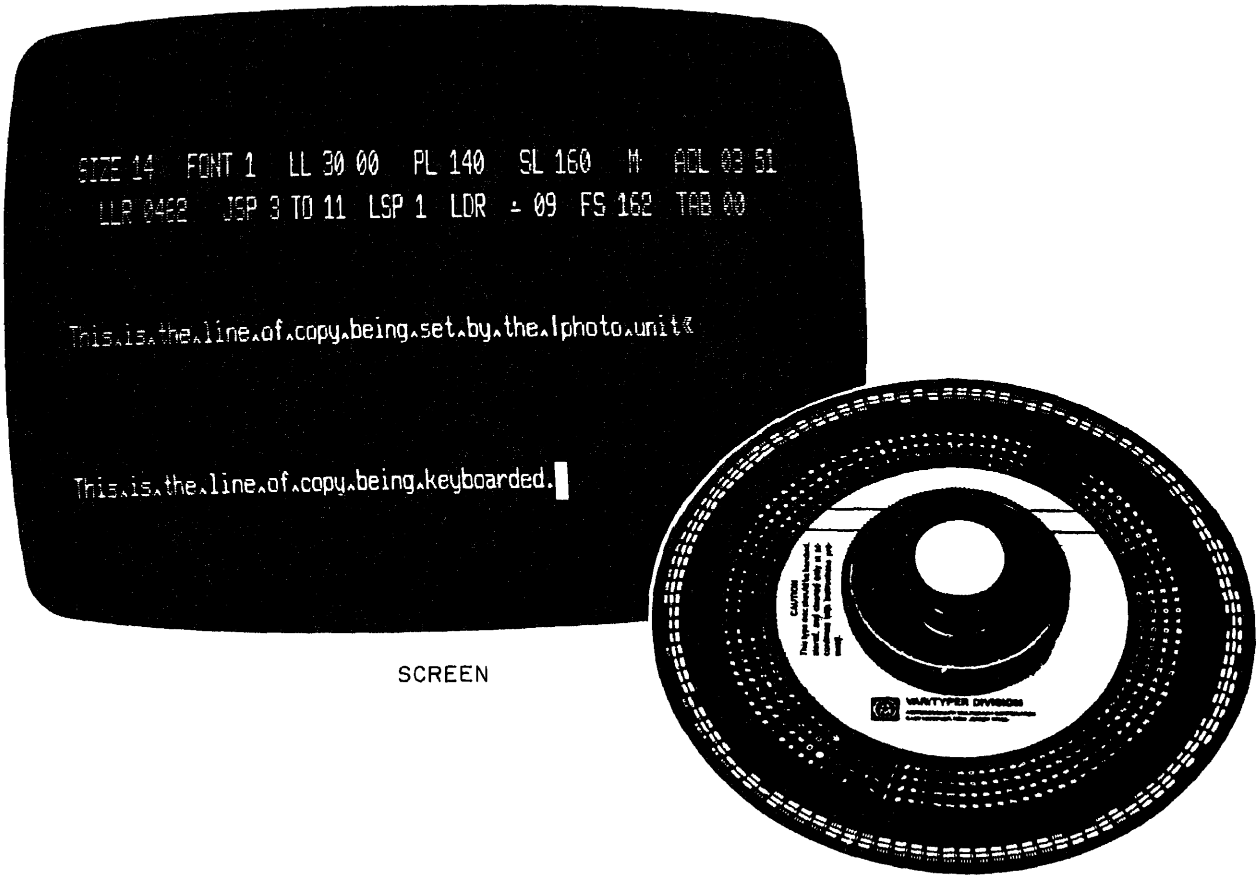
The keyboard looks like that of a standard typewriter because the alphabet and number keys are in the same position as on a standard typewriter. (See fig. 3-5.) Also located on the keyboard, are "Function" keys that are used to transmit instructions to the typesetter (for example, type size, length of line, or any special copyfitting instructions).

Screen

Directly above the keyboard is a television-like screen on which the character image is projected (see fig. 3-5). This screen has three sections of view:

- The function field
- The last line typed
- The line being typed

These three sections of view are shown in greater detail in figure 3-6.



```
SIZE 14  FONT 1  LL 30 00  PL 140  SL 160  M  ADL 03 51
 LLR 0462  JSP 3 TO 11  LSP 1  LDR ± 09  FS 162  TAB 00

This‸is‸the‸line‸of‸copy‸being‸set‸by‸the‸|photo‸unit«

This‸is‸the‸line‸of‸copy‸being‸keyboarded.█
```

SCREEN

TYPE DISC

The function field is located at the top of the screen. It shows the main functions being used in the present job. The function field gives the operator an overview of type size and length of line, and so forth.

As the operator types, copy appears on the screen. (See figure 3-6.) The last line to appear on the screen is always the line of copy that the operator is typing or the line that the operator has just completed typing. This last line can be edited by using one of the function keys (for example, delete, overstrike). When the return key is depressed, the line will move up on the screen and the typesetter will set the line of copy. The next line can be typed by the operator while the typesetter is setting the last line.

Typesetter

The typesetter receives the information from the Comp/Edit keyboard and transmits it photographically through the type disc to the photographic paper. The lens mechanism inside the Comp/Edit typesetter can produce many different sizes of type since it requires no manipulation or maintenance by the operator.

The two major elements of interest to the operator for the typesetter are the "type disc" and "paper cassette."

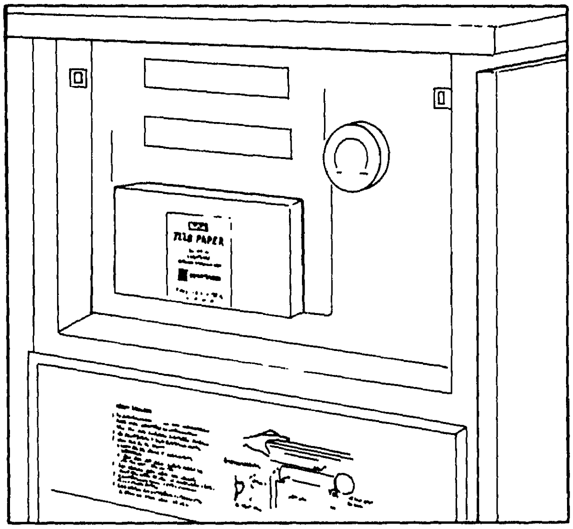
TYPE DISCS.—The Comp/Edit discs contain different styles of type. They are manufactured as a circular film piece with a disc retaining handle at the center. A sample of a type disc is shown in figure 3-6.

PAPER CASSETTE.—This cassette is light-tight and carries the photographic paper (see fig. 3-7). When the keyboard operator selects a character, a small light passes through the type disc and projects the image of the character onto the photographic paper.

Located on the front right side of the typesetter is the footage indicator. The footage indicator shows the total amount of photographic paper used. Each time a different paper cassette is put into the typesetter, the footage indicator should be reset.

DISPLAY COMPOSITION

Type larger than 14 point is classified as display type. Display composition may consist of hand lettering, paste-down letters, or material produced on photo-composing equipment.



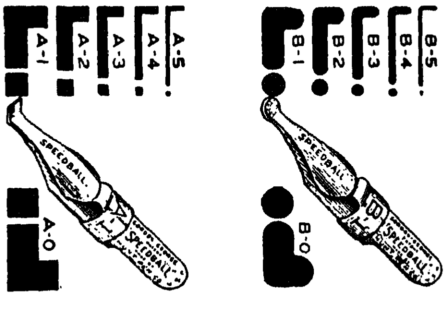
57.375

Figure 3-7.—Varityper Comp/Edit paper cassette inside the front of the typesetter.

HAND LETTERING

Hand lettering gives work a friendly, informal tone. It can be made to fit into almost any space or design in the preparation of photo-offset copy.

Although Navy Lithographers seldom use hand lettering for reproduction, it should be done with a pen or brush and with india ink or black water colors. Precision lettering, of course, requires ruling the outlines of the letters with a ruling pen and filling them in with a brush. Fine pen points, such as Gillot's 303 or crow quill pens may be used for squaring up corners; and chinese white may be used to touch out raggedness. Special lettering pens, such as the Speedball pens shown in figure 3-8 are sometimes used for freehand work.



45.123

Figure 3-8.—Speedball pen points.

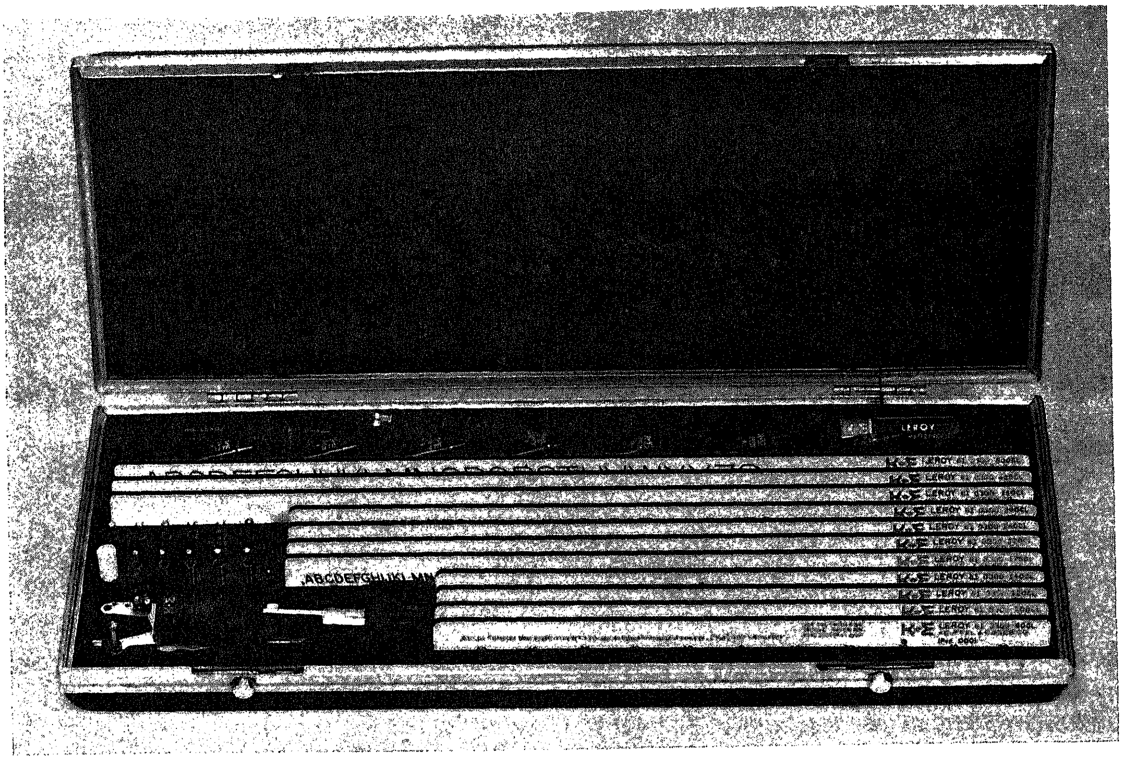


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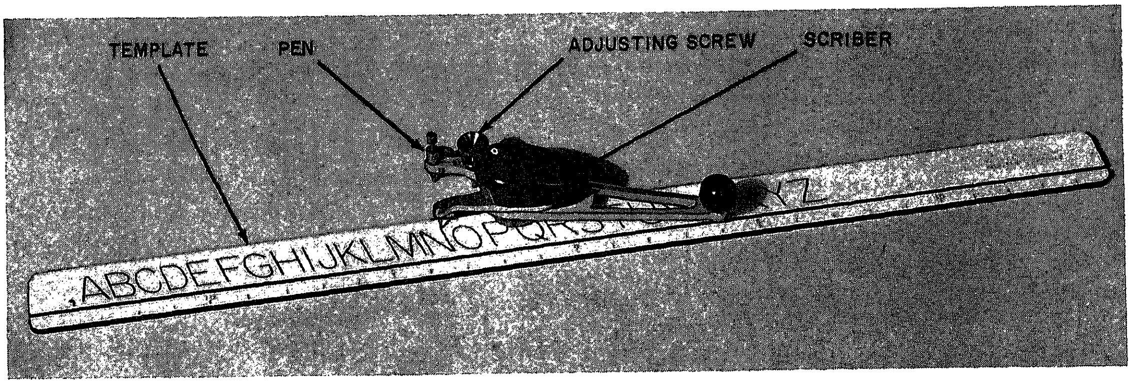
Figure 3-9.—A Leroy lettering set.

MECHANICAL LETTERING

Lettering is an art and it takes a great deal of practice to become proficient at it. If you are not an artist, there are a number of mechanical devices available for use. For example, the Leroy is a mechanical lettering instrument that can be used. (See fig. 3-9.) A pen that is gaged to produce letters of even thickness is inserted into a device known as a scriber. The scribe is moved along a template or lettering guide. (See fig. 3-10.) Leroy pens are supplied in a variety of sizes for different thicknesses of line, and templates are available for several sizes of letters.



The operator produces italics with the Leroy set by adjusting the arm of the scriber. Leroy letters always have rounded corners, but the corners can be squared with a fine-pointed pen. Letters squared in this manner look much the same as single-stroke brush lettering.

Mechanical lettering, as with hand lettering, is seldom used by Navy Lithographers. A Draftsman (DM) usually provides these services.

Art Type and Visi-Type

There are a number of typefaces and sizes that are printed on sheets of transparent acetate or cellophane. These sheets are waxed on one side for pastedown purposes. The letters can be simply cut out with a knife and applied directly to the master copy. (See fig. 3-11.) One advantage of using these letters is that they can be applied directly to artwork without covering the art or blocking it off with surrounding white space. Another advantage is that they do not leave a shadow outline on the negative when the work is photographed, provided they have been thoroughly burnished.

Pressure-Transfer Lettering

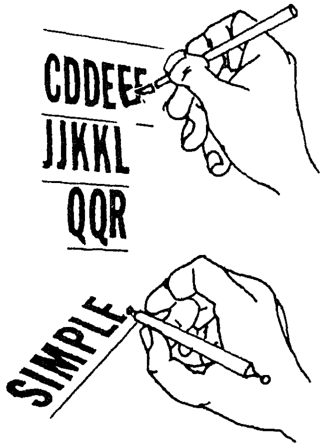
Pressure-transfer lettering is similar to Art Type and Visi-Type in that the letters of the alphabet are printed on acetate sheets. But instead of cutting the letter out of the acetate sheet and attaching them to the artwork, you can pressure transfer lettering.

As shown in figure 3-12, to pressure transfer lettering you simply move the sheet of pressure-transfer letters until the desired letter is in the proper position, then rub the front of the sheet with a burnisher.

Although pressure-transfer letters can be used without spraying, they are usually sprayed with three or four coats of a plastic fixative if rough or repeated use is required. You can remove a letter with an ordinary pencil eraser if you make a mistake when applying it.

PHOTOLETTERING MACHINES

Several types of photolettering machines are used for producing display lettering. Some of the machines are equipped to produce type sizes from 4 point through display type sizes and to produce positive or negative copies on film or paper.

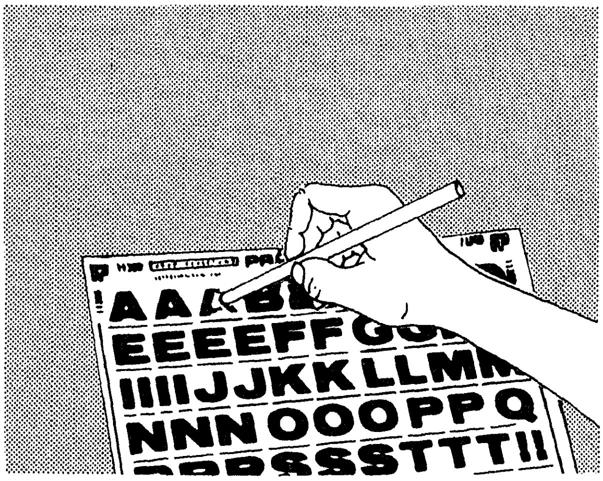


57.15

Figure 3-11.—Paste-down lettering may be used for display faces.

HEADLINER

The Varityper Headliner is used to produce cold type photo-composition and is commonly found in Navy lithographic shops. It has the capability of exposing, developing, fixing, and washing either film or paper; it produces positive copy on 35-mm film or paper. Although composition on paper is generally preferred for paste-up purposes, the term film or paper will be used when discussing the Varityper Headliner.



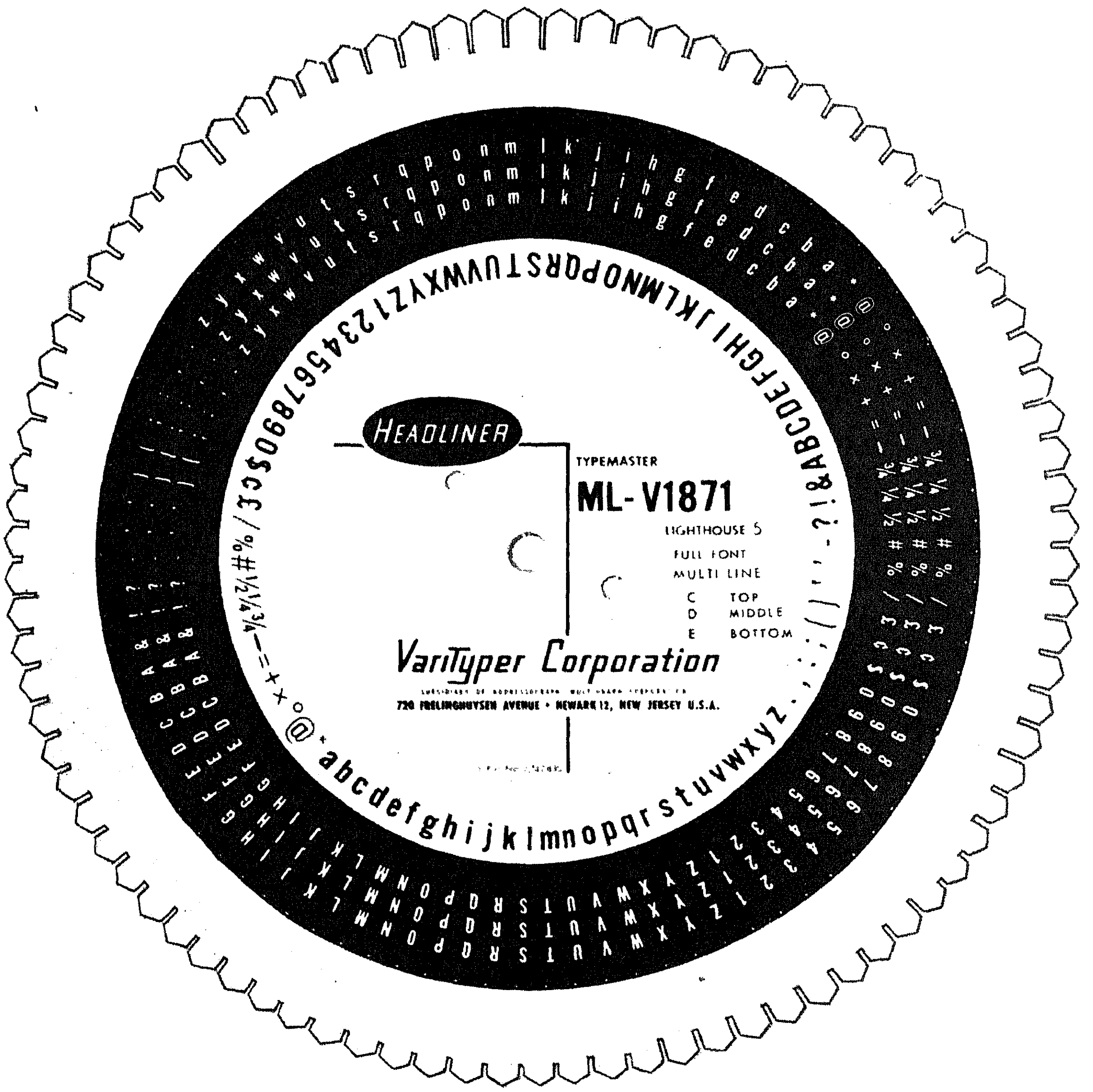
57.15

Figure 3-12.—Transfer lettering.

Within the Headliner, copy is produced from a large plastic disc called a TypeMaster. (See fig. 3-13.) The TypeMaster contains a master negative of all the letters of the alphabet. The negative is laminated on the plastic disc and slots are cut at the edge of the disc to provide the proportional spacing for the individual characters. There are deep slots for wide letters like the "M" and the "W" and shallow slots for thin letters like the "i" and the "l."

Typefaces are available on TypeMasters in sizes from 10 to 84 points. Most TypeMasters carry a full font of type; however, the larger sizes of type have one disc for the uppercase (capital) letters and another disc for the lowercase letters. These TypeMasters are termed "half fonts."

Before you begin studying the set-up and operation of the Headliner, examine the various illustrations in figures 3-13 through 3-19.


HEADLINER
TYPEMASTER
ML-V1871
LIGHTHOUSE 5
FULL FONT
MULTI LINE
C TOP
D MIDDLE
E BOTTOM
VariTyper Corporation
720 FRELINGHUYSEN AVENUE • NEWARK 12, NEW JERSEY U.S.A.
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890$¢
abcdefghijklmnopqrstuvwxyz

142.333X

Figure 3-13.—A typical TypeMaster. In this example the identification number is ML-V1871. The first two digits (18) indicate the type size in points. The next line shows the lighthouse setting (5), and the following line indicates the font setting (full).

Machine Set-up

As an operator, you must perform several operations before beginning composition on the Headliner. These operations include preparing the developer tank, inserting the film or paper, and setting the exposure and spacing controls. We will discuss each of these operations.

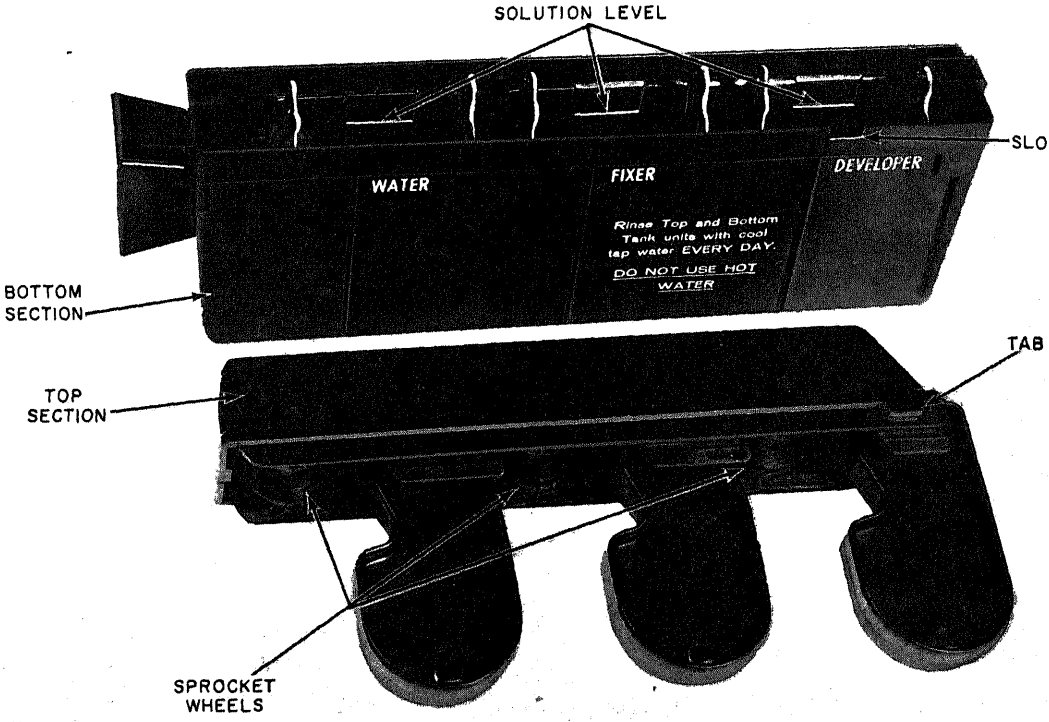
DEVELOPING TANK.—The exposed film or paper is fed into the developing tank, which is divided into three separate compartments; one each for the developer, fix, and wash solutions. The developing process is completely automatic; that is, there is no provision to visually inspect the exposed film or paper during the development process. The film or paper is carried through the developing tank by chain-driven sprocket wheels, which are located on the top section of the tank. (See fig. 3-14.)

The developer and fix processing solutions used in the developing tank are mixed according to the manufacturer's instructions. There are two types of solutions: a powder concentrate, which is premixed and stored in amber colored bottles and used as needed; and a liquid solution, which requires no premixing and is ready to use.

To fill and insert the developing tank into the Headliner machine you should:

1. Pour the developer and fix solutions and wash (which is ordinary tap water) into their respective compartments in the bottom section of the developing tank. Each compartment has an internal marking to indicate the proper filling level. (Refer to fig. 3-14.)
2. Place the top section of the tank into the bottom section, by aligning the tab of the top section into the slot of the bottom section.
3. Insert the tank into the machine at the opening on the right side. Make sure the tank is in as far as it will go. (You may find it helpful to have the machine turned on when inserting the tank. This will ensure that the sprockets on the tank will not catch on the chain that drives them.)

FILM OR PAPER LOADING.—The film or paper used in the Headliner is packaged in a

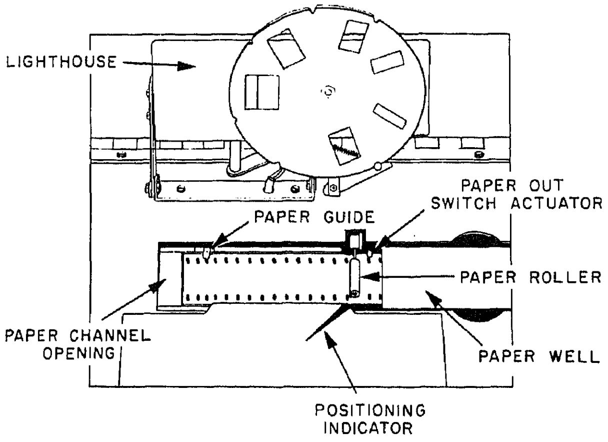


142.331X

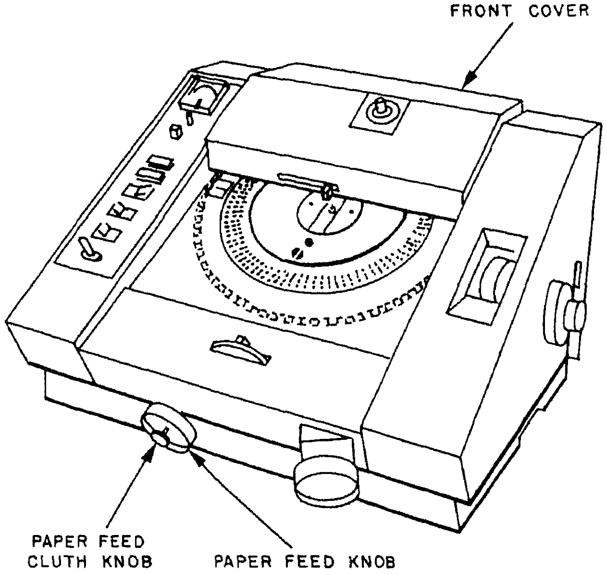
Figure 3-14.—Headliner developing tank.

light-proof cartridge, which is easily inserted into the machine. You should refer to figure 3-15 when performing the following steps:

1. Raise the front cover and lighthouse. (The lighthouse is located underneath the front cover.)
2. Pull out the paper feed clutch knob.
3. Insert the paper cartridge into the well.
4. Raise the paper roller.
5. Feed the film or paper underneath the paper out switch actuator, along the paper channel under the edge of the positioning indicator, underneath the paper guide and into the opening at the left end of the paper channel.
6. Push in the paper feed clutch knob.
7. Turn the paper feed knob clockwise and observe the film or paper feed in the channel. If the film or paper does not feed along the channel, the film or paper has not been inserted far enough into the left channel opening. To correct this, pull the paper feed clutch knob out and slide the film or paper to the left, deeper into the channel opening.
8. Press down on the paper with your hand to remove the bow from the paper in the channel when the film or paper is feeding properly.
9. Lower the paper roller to hold the film or paper in position.
10. Close the lighthouse front cover.



AREA UNDER THE FRONT COVER



THE HEADLINER

142.332X

Figure 3-15.—Inserting paper cartridge in the headliner.

INSERTING THE TYPEMASTER.—The TypeMaster is positioned under the lighthouse as shown in figure 3-15. Raise the front cover of the lighthouse and place the TypeMaster on the large center pin on the drive plate. Turn the selector knob until the side locating pins (see fig. 3-16) enter the TypeMaster. To ensure that the TypeMaster is firmly seated, press down on it with your hand. Lower the front cover of the lighthouse.

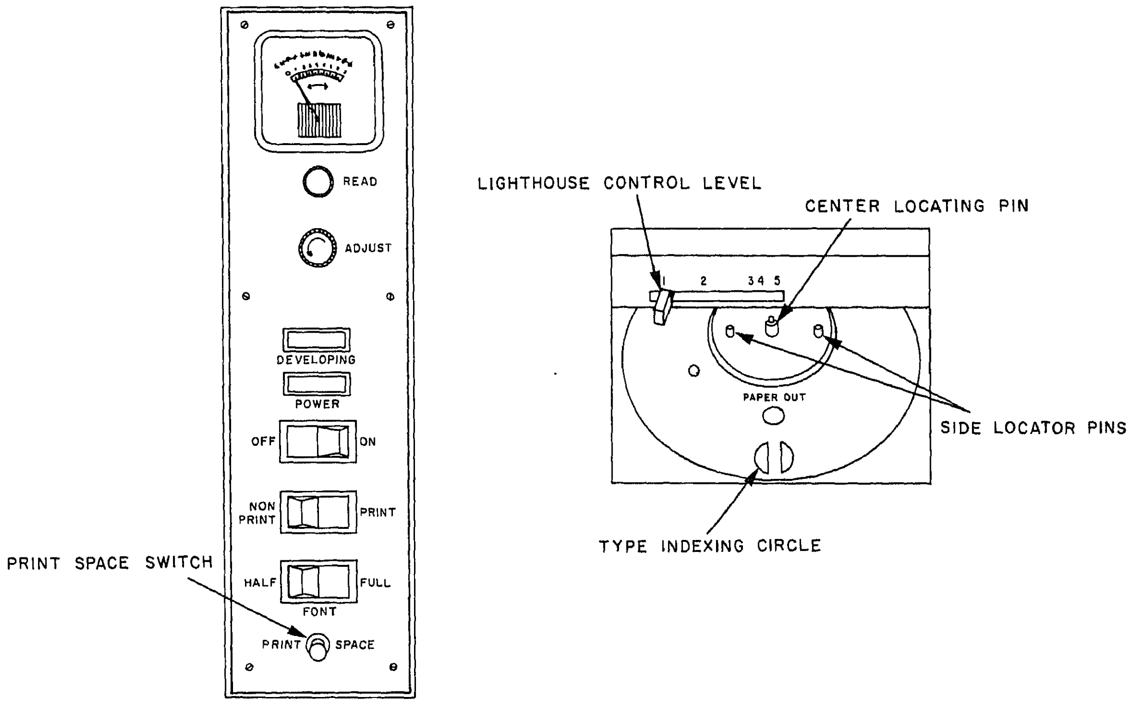
You are now ready to set the lighthouse setting and the wordspacing and letterspacing dials. The correct wordspacing and lighthouse setting are printed on each TypeMaster.

LIGHTHOUSE SETTINGS.—The lighthouse is a series of openings that light passes through to expose the character on the film or paper.

The lighthouse setting determines the amount of light that the lighthouse allows to pass through the TypeMaster to the film or paper. If the opening is too large, a portion of the other characters will print; if the opening is too small, you will lose some of the character. You must adjust the lighthouse setting according to the size of the character being printed.

To set the lighthouse, move the lighthouse control lever, shown in figure 3-16, to the lighthouse setting indicated on the TypeMaster.

WORDSPACING.—The unit of measurement used to define the size of the Headliner type is in points. You must vary the space setting according to the size of the letters on the TypeMaster to get the proper wordspace.

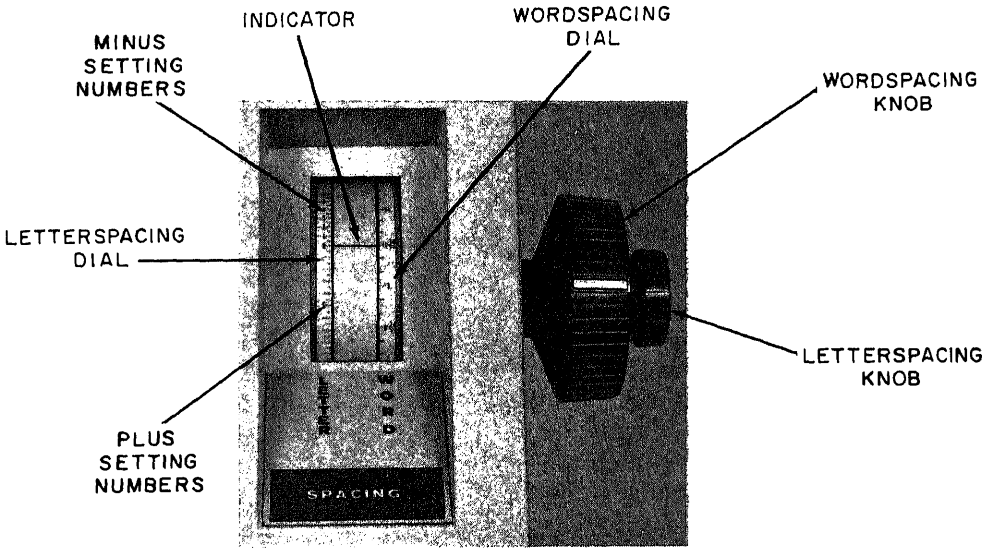


142.334

Figure 3-16.—Headliner control panel and drive plate.

Turn the wordspacing knob, shown in figure 3-17, until the point size on the wordspacing dial corresponds with the point size indicated on the TypeMaster. For example, if you are using a 36-point TypeMaster, set the wordspacing dial at 36 points.

LETTERSPACING.—The letterspacing knob is located directly to the right of the wordspacing knob. The letterspacing dial indicates the amount of spacing that is placed between the individual characters. You can set the letterspacing dial with the letterspacing knob, as shown in figure 3-17.



142.335X

Figure 3-17.—Headliner spacing controls.

The normal setting is "0"; however, this setting may be advanced or decreased for either a plus or minus spacing. For example, if you find that the space a line or word is to fit into is limited, you can use closer spacing between the letters by setting the letterspacing dial to the " – ," or minus side of "0." Conversely, you can stretch a line or word by setting the dial on the " + ," or plus, side of "0."

(Note: When you are setting either the wordspacing or letterspacing dial, always arrive at your desired setting from a higher setting. For example, if you have selected a 24-point TypeMaster, turn the wordspacing dial to a point size greater than 24 points and then move down to 24 points.)

In the case of letterspacing, first turn the letterspacing knob so that " – 9" is aligned with the dial indicator and then turn back to your desired setting. This method will ensure a precise setting.

LINE LENGTH DIAL.—The line length dial, pointed out in figure 3-18, indicates the cumulative amount of paper that has been used. It moves when the print/space switch is operated or when the paper feed knob is turned. If you want to bring the dial to "0" without movement of the paper, you should move the dial by hand.

The dial is marked in inches and picas to aid in copyfitting measurement calculations.

LINE SELECTOR.—The line selector knob has the capability to print multiple lines of copy from a special TypeMaster. The selector knob must be in the "N" (normal) position when printing with a TypeMaster that has only one line of characters. If the machine you are using is this model, it will have a line selector knob, as shown in figure 3-18.

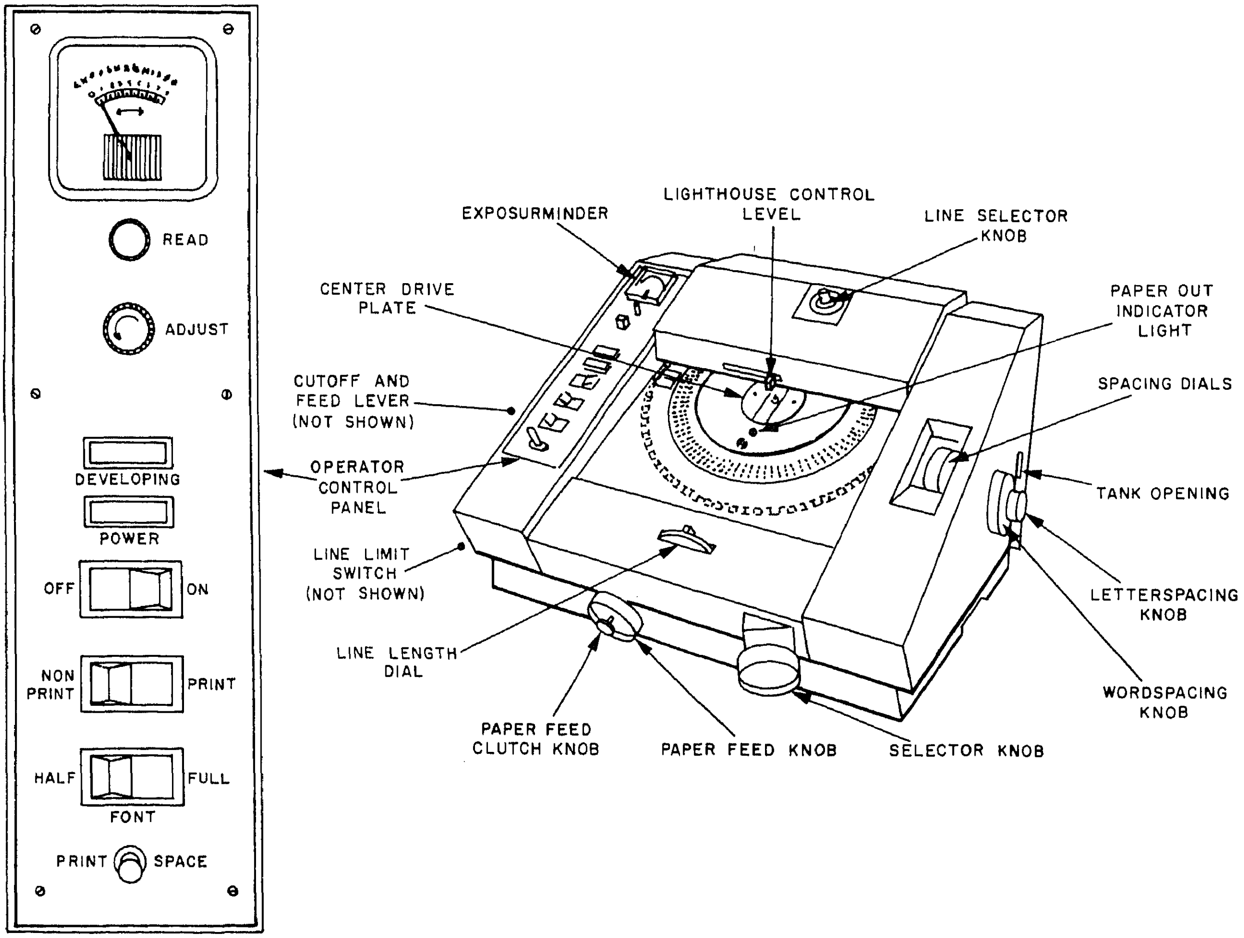


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Figure 3-18.—Varityper Headliner 860.

EXPOSUREMINDER.—The exposureminder (see fig. 3-18) is a meter that is used to assist in maintaining a uniform electrical current to the lighthouse lamp, thereby ensuring a uniform light intensity and proper character density.

Associated with the meter is a read pushbutton and an adjust knob, as shown in figure 3-18. To check the value of the lamp current, you should depress the read pushbutton. When this button is depressed, the current flows through the lamp; thus the paper directly under the lighthouse is exposed. After you check and/or adjust the lamp current, advance approximately one inch of the exposed paper.

The adjust knob is used to set the lamp current at the desired level as monitored at the exposureminder. The normal exposureminder setting is 5. This setting does not have to be changed for different sizes or styles of characters. It can, however, be adjusted to lighter or darker values to meet certain requirements, such as when underexposure is desirable because of hot developer, or overexposure is necessary to compensate for worn-out developer.

FONT SWITCH.—The font switch, shown in figure 3-18, has two positions, half and full. Set it at the full position if the TypeMaster you are using contains both uppercase and lowercase letters. If your TypeMaster has only uppercase (or lowercase) characters, you should set the font switch at the half position.

PRINT/SPACE SWITCH.—Occasionally you will want to know how much space a word or line will occupy before it is printed. When the print/space switch, shown in figure 3-18, is placed in the space position, the lighthouse lamp will not expose the film or paper. The film or paper that has not been exposed can be used again by disengaging the paper feed clutch and turning the paper feed knob counterclockwise. The film or paper will then return to the cartridge. When you are operating the print/space switch only in the print position, a piece of tape may be placed over the space portion of the switch to prevent it from being moved inadvertently to the space position. Otherwise, you may find that you have not been exposing the copy you have been composing.

Machine Operation

To operate the Varityper Headliner, you should perform the following steps:

1. Select the character you wish to print. This is accomplished by turning either the selector knob, shown in figure 3-18, or the TypeMaster itself.
2. Position the desired character in the center of the type indexing circle.
3. Move the print/space switch to the print position until the exposure has been made. Repeat these steps for the remainder of the word.

To space between the words, move the print/space switch to the space position. When you have completed your composing, turn the paper feed knob until the line length dial has made one complete revolution, plus one inch. (The extra inch ensures that the exposed paper will clear the cutting knife.) Raise the cutoff lever and hold it in the up position until the developing light comes on. The paper is now entering the developing tank. The cutoff lever may now be released.

The minimum amount of film or paper that can be fed into the developing tank is 13 inches. When 13 inches have passed the cutoff lever, the lever cannot be raised. Accordingly, for a short line or word, it will be necessary to feed the film or paper manually with the paper feed knob until 13 inches of film or paper have been fed into the storage chamber.

The maximum amount of film or paper that may be printed and stored before development is 4 1/2 feet. A bell will sound at four feet to alert you that you are within 6 inches of the film or paper maximum. If the bell is not heeded, the machine will automatically shut down when 4 1/2 feet is reached. When this occurs, advance the film or paper with the paper feed knob until the line length dial makes one complete revolution, plus 1 inch. Then raise the cutoff lever to start the machine and feed the paper through the developing tank.

If you are in the middle of a word when the machine shuts down, you may complete the word by using the line limit switch, shown in figure 3-19. By depressing this switch, you will override the automatic shutdown mechanism.

After the film or paper comes out of the machine, it is a good practice to rinse it in plain tap water to remove all traces of the processing solutions. If you are using film, it will be necessary to place the film in a tray of hypo solution to clear it completely. You will learn more about hypo in a later chapter.

Maintenance

The Varityper Headliner should be cleaned after each 8 hours of use. If it is not cleaned regularly, residue from the processing solutions will continue to accumulate and eventually problems will occur.

To clean the developing tank, you should use a commercial photo cleaner or cool tap water with a detergent. NOTE: Never use hot water to clean the developing tank because the heat may cause it to warp. After you have cleaned the developing tank, it must be thoroughly rinsed.

Clean the TypeMasters with a damp rag and always store them in a flat position. Avoid placing the TypeMasters in a hot area, as the heat may cause warpage.

The chart shown in table 3-1 details the most common operational difficulties and their solutions for the Varityper Headliner. For detailed maintenance and adjustment procedures, refer to the manufacturer's instruction manual.

Note: Before Navy Lithographers operate, adjust, or repair any piece of equipment, they must have a copy of either the operator's manual or the NAVSEA technical manual for step-by-step procedures.

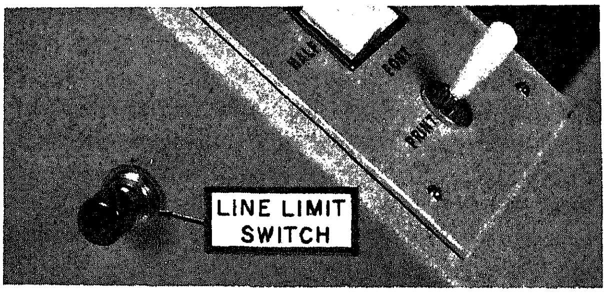

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Figure 3-19.—Line limit switch.

PROOFREADING

Everyone makes a mistake once in awhile. That is to be expected. However, as a printer you should check or proofread the copy thoroughly before it goes to camera or press.

It could be embarrassing to everyone involved to let a story go to press reading: "The deeds of the admiral will remain immoral in the minds of seafaring men" when it should have read "remain immortal."

It could be extremely disastrous to let something like this go by: "Commence shore bombardment Blue Beach I 0200Z" when it should have read "Commence . . . 0020Z."

Two persons are generally assigned to proofread a job. One reads aloud from the original copy and the other checks the proof. The proofreader does not make any changes except where there are typographical errors such as misspelling of common words, and so on. If one person discovers an error of fact in the original copy, that person should query it (put a question mark in the margin of the proof) and take it up later with the PO in C.

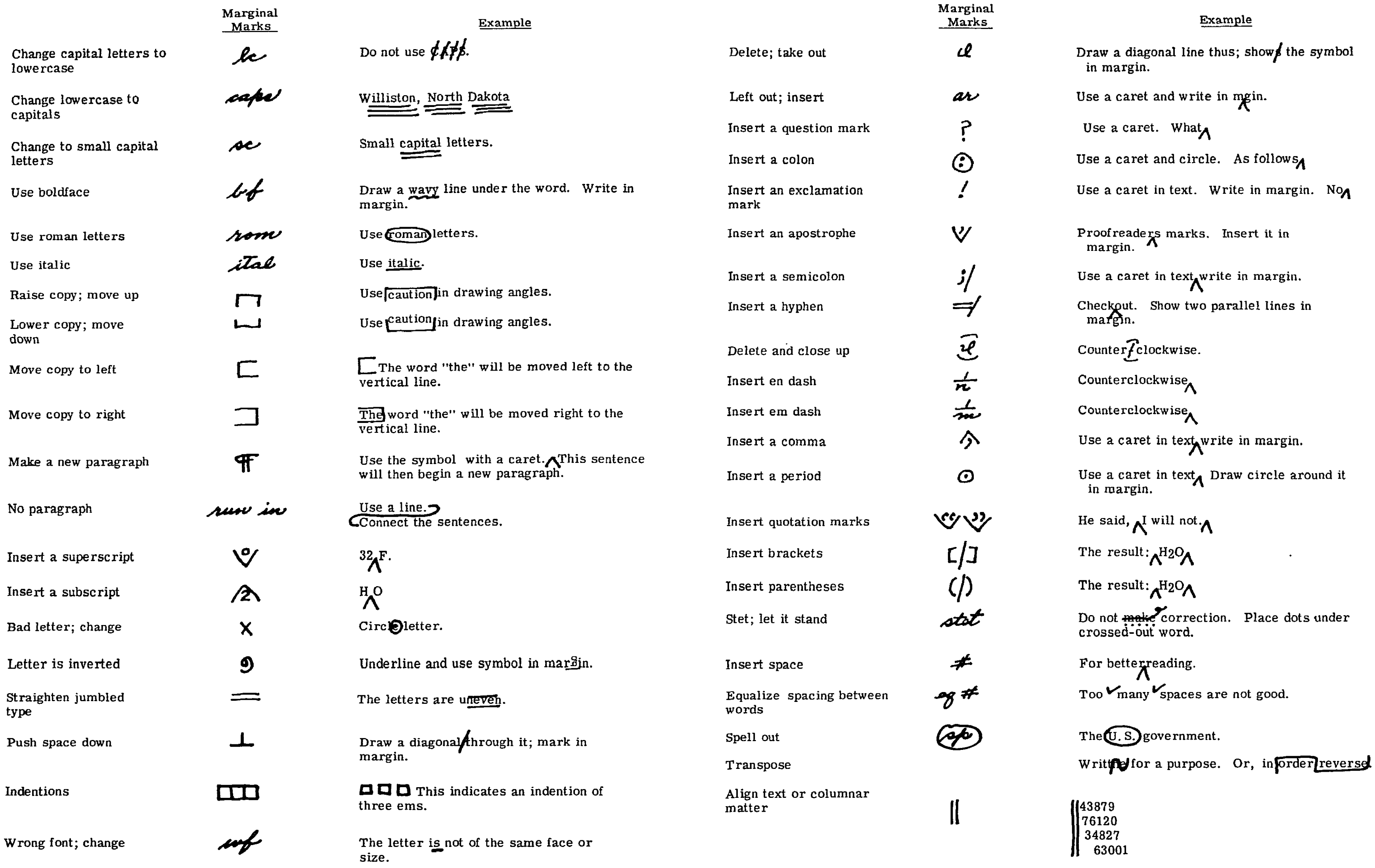
Always read all punctuation; spell out unusual or proper names; check for paragraph indentions and improper capitalization. You, as the proofreader, should double check for the transposition of letters, such as ie and ei and for homonyms, such as way and weigh. These words may sound alike but have different meanings. So be sure to check the spelling in relation to the content.

In addition to checking for such errors as mistakes in spelling and punctuation, you should also check proofs for proper type sizes, proper placement of headings, and proper spacing. You can see, proofreading is an important operation in the lithographic process.

A lithographer must be able to transfer the errors found in the copy back to the composer by the use of proofreader's marks so that

Table 3-1.—Headliner Operation Troubleshooting

Problem	Cause	Solution
Blank paper after printing and developing	A. Chemicals not correctly mixed or in wrong tank compartments	A. Replace chemicals
	B. Exposure bulb is loose or burned out	B. Tighten or replace bulb
Indistinct or grayish characters	A. Underexposure	A. Set Exposureminder to a higher setting
	B. Developing solution has become weak from use	B. Replace with fresh developer
Characters not sharp	A. TypeMaster not firmly seated on drive plate	A. Press TypeMaster down on drive plate
	B. Overexposure	B. Set Exposureminder to a lower setting
	C. Warped TypeMaster	C. Replace TypeMaster
One side of characters cut off	A. Incorrect lighthouse setting for TypeMaster used	A. Reset lighthouse opening
Characters overlapping	A. Font switch not in proper position for half font TypeMaster	A. Move front switch to half font position
	B. If one character consistently touches the next character, its slot may have dirt in it	B. Clean slot with knife blade blade or fine file
	C. Bind in paper	C. Check paper feed
	D. Bind in TypeMaster	D. Check rotation of TypeMaster make sure it isn't binding on the lighthouse
Developing light remains on and paper does not come out of developing tank	A. Tank not properly inserted	A. Push tank further in machine
Developing light will not light; paper does not feed into developing tank when cutoff lever is raised	A. Paper jammed in sprocket housing	A. Open back cover and clear sprocket housing
Cutoff lever will not raise	A. Minimum amount of paper (13 inches) has not been used	A. Turn paper feed knob to obtain 13 inches of paper in storage chamber
Machine shuts off	A. Maximum amount of paper passed (4½ feet)	A. Raise cutoff lever to feed paper into developing tank



	Marginal Marks	Example
Change capital letters to lowercase	lc	Do not use ~~CAPS~~.
Change lowercase to capitals	caps	Williston, North Dakota
Change to small capital letters	sc	Small capital letters.
Use boldface	bf	Draw a wavy line under the word. Write in margin.
Use roman letters	rom	Use roman letters.
Use italic	ital	Use italic.
Raise copy; move up	⊓	Use caution in drawing angles.
Lower copy; move down	⊔	Use caution in drawing angles.
Move copy to left	⊏	The word "the" will be moved left to the vertical line.
Move copy to right	⊐	The word "the" will be moved right to the vertical line.
Make a new paragraph	¶	Use the symbol with a caret.∧This sentence will then begin a new paragraph.
No paragraph	run in	Use a line. Connect the sentences.
Insert a superscript	∨	32∧F.
Insert a subscript	∧	H∧O
Bad letter; change	×	Circle letter.
Letter is inverted	9	Underline and use symbol in margin.
Straighten jumbled type	=	The letters are uneven.
Push space down	⊥	Draw a diagonal/through it; mark in margin.
Indentions	☐☐☐	☐☐☐ This indicates an indention of three ems.
Wrong font; change	wf	The letter is not of the same face or size.
Delete; take out	ℓ	Draw a diagonal line thus; shows the symbol in margin.
Left out; insert	ar	Use a caret and write in m∧gin.
Insert a question mark	?	Use a caret. What∧
Insert a colon	(:)	Use a caret and circle. As follows∧
Insert an exclamation mark	!	Use a caret in text. Write in margin. No∧
Insert an apostrophe	∨	Proofreaders marks. Insert it in margin.
Insert a semicolon	;/	Use a caret in text∧write in margin.
Insert a hyphen	=/	Checkout. Show two parallel lines in margin.
Delete and close up	ℓ	Counter clockwise.
Insert en dash	1/n	Counterclockwise∧
Insert em dash	1/m	Counterclockwise∧
Insert a comma	∧	Use a caret in text∧write in margin.
Insert a period	⊙	Use a caret in text∧ Draw circle around it in margin.
Insert quotation marks	∨ ∨	He said, ∧I will not.∧
Insert brackets	[/]	The result: ∧H2O∧
Insert parentheses	(/)	The result: ∧H2O∧
Stet; let it stand	stet	Do not ~~make~~ correction. Place dots under crossed-out word.
Insert space	#	For better∧reading.
Equalize spacing between words	eq #	Too many spaces are not good.
Spell out	sp	The U.S. government.
Transpose		Written for a purpose. Or, in order reverse.
Align text or columnar matter	‖	43879 76120 34827 63001

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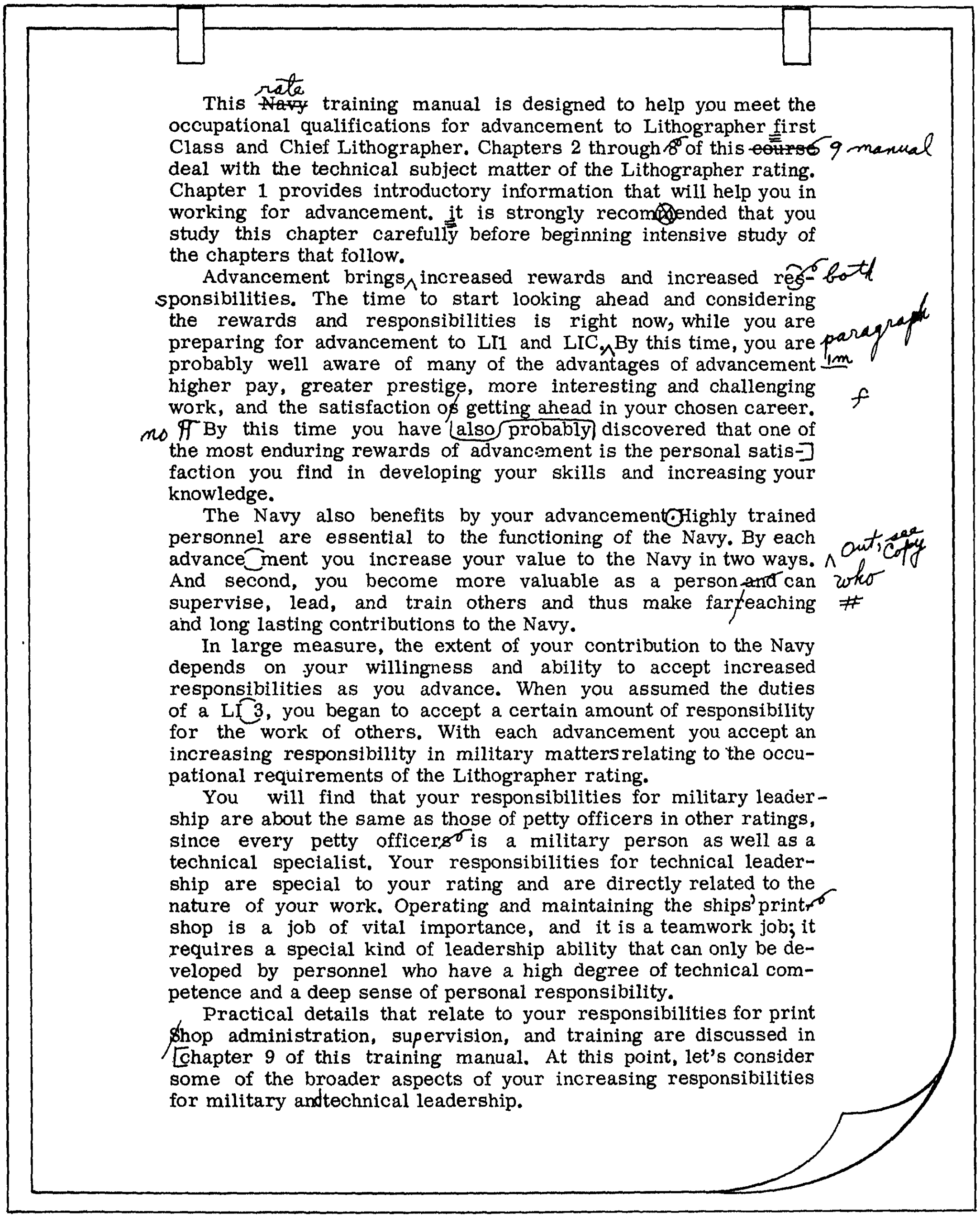
Figure 3-20.—Proofreader's marks, their placement and uses.

corrections can be made. Figure 3-20 details the proofreader's marks and their uses.

Figure 3-21 shows the proofreader's marks and how they are placed on the copy. These marks may vary somewhat in civilian life from shop to shop; but in the Navy, you will use them and you must know them as part of your occupational standards.

Proofreader's marks are actually a code used to eliminate written explanations to the compositor.



This ~~Navy~~ rate training manual is designed to help you meet the occupational qualifications for advancement to Lithographer first Class and Chief Lithographer. Chapters 2 through ~~8~~ of this ~~course~~ 9 manual deal with the technical subject matter of the Lithographer rating. Chapter 1 provides introductory information that will help you in working for advancement. it is strongly recomended that you study this chapter carefully before beginning intensive study of the chapters that follow.

Advancement brings ^ increased rewards and increased re~~s~~sponsibilities. both The time to start looking ahead and considering the rewards and responsibilities is right now, while you are preparing for advancement to LI1 and LIC. ^ By this time, you are paragraph probably well aware of many of the advantages of advancement 1/em higher pay, greater prestige, more interesting and challenging work, and the satisfaction o~~s~~ getting ahead in your chosen career. f
no ¶ By this time you have also probably discovered that one of the most enduring rewards of advancement is the personal satisfaction you find in developing your skills and increasing your knowledge.

The Navy also benefits by your advancement. Highly trained personnel are essential to the functioning of the Navy. By each advance ment you increase your value to the Navy in two ways. ^ Out, see copy And second, you become more valuable as a person ~~and~~ who can supervise, lead, and train others and thus make far/reaching # and long lasting contributions to the Navy.

In large measure, the extent of your contribution to the Navy depends on your willingness and ability to accept increased responsibilities as you advance. When you assumed the duties of a LI 3, you began to accept a certain amount of responsibility for the work of others. With each advancement you accept an increasing responsibility in military mattersrelating to the occupational requirements of the Lithographer rating.

You will find that your responsibilities for military leadership are about the same as those of petty officers in other ratings, since every petty officer~~s~~ is a military person as well as a technical specialist. Your responsibilities for technical leadership are special to your rating and are directly related to the nature of your work. Operating and maintaining the ships' print~~s~~ shop is a job of vital importance, and it is a teamwork job; it requires a special kind of leadership ability that can only be developed by personnel who have a high degree of technical competence and a deep sense of personal responsibility.

Practical details that relate to your responsibilities for print Shop administration, supervision, and training are discussed in Chapter 9 of this training manual. At this point, let's consider some of the broader aspects of your increasing responsibilities for military andtechnical leadership.

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Figure 3-21.—Cold type composition corrections. When marking cold type copy corrections, the proofreader tapes a sheet of tissue over the proof and marks corrections on the tissue overlay at the point where they occur. This avoids the correction marks appearing on the negative when the proof is photographed.

For example, when you see the word "stet" on a proof, you know at once that it means, "Don't change this—even though a change was indicated—let it stand as it is."

Some proofreaders draw a line or kite tail from the error in the text body to the margin and write in the correction there. This method is not recommended and should never be used on reproduction proofs or direct-image plates. When you are reading proof on reproduction copy, corrections should be made in light blue pencil in the margin. A water soluble pencil or fountain pen is best for marking plates, since the marks will not take ink when the plate is run on the press and will wash off completely in most cases.

MAKING CORRECTIONS

You may use several methods to make corrections to cold type composition. Occasionally a simple erasure or the application of white opaque correction fluid may do the job. Because of the possibility of the error showing through, most corrections to cold type copy should be made by cutting in the correction in the place of the error. See fig. 3-22.

Cut-in corrections are made by placing the copy over a light table and aligning the correction over the error. Refer to fig. 3-22.

Section (A) shows a rectangular cut being made through the correction and the original copy with a single edge razor blade or a copy knife.

Section (B) shows the error removed from the copy and the correction being placed into the cutout area.

Section (C) suggests that if you cut the error and correction at a slight angle, you will prevent the correction from being placed into the cut area upside down. The correction is held in place by tape, which is applied to the back of the copy. With practice, you should be able to make perfectly aligned cut-in corrections.

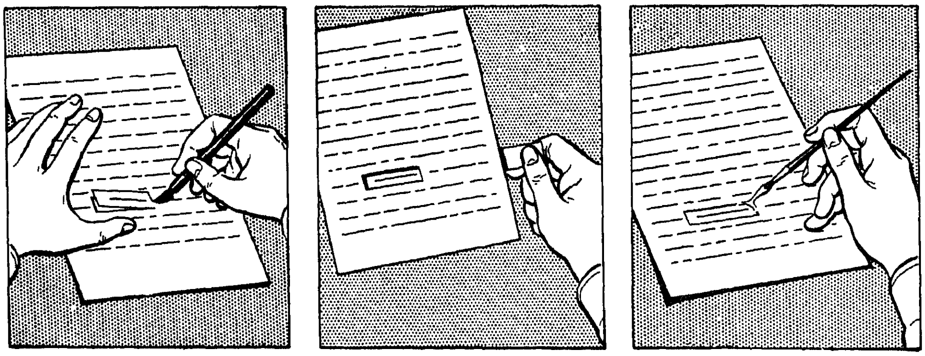
FOR LI1 AND LIC CANDIDATES ONLY

The following information on Forms Design is required for LI1 and LIC candidates only. LI3 and LI2 candidates are not required to read this designated section.

FORMS DESIGN

The composition of a form can be accomplished by using more than one method. Your particular choice of method depends on the equipment available and the design of the form. However, you should take into consideration certain advantages and disadvantages to each method.

One method that is commonly used by printers today consists of setting up the complete form on an electric or electronic composing machine with ruling capability. This method has the advantage of turning out camera-ready copy in one operation. However, this type of work requires an operator who is experienced in forms composition; and generally speaking, the average



A B C

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Figure 3-22.—Making cut-in corrections on cold type copy.

shipboard shop doesn't do enough original forms work to keep an operator efficient at this type of composition.

If your composing machine is not equipped with a ruling capability, you could use the method of ruling in the lines by hand. The ruled-in lines should be drawn with light blue (nonreproducing) pencil in their proper position based on the design of the form. This should be done preferably on forms design or graph paper. Then using the rules as reference points, you can type in the text.

Once you have typed in the text, the rule lines are then drawn in with india ink for photographic reproduction.

When you use the paste-up method, the text is composed on a cold type composing machine. Then the individual captions, headlines, and lines are cut apart and pasted on a layout that has been ruled in india ink as a separate operation.

When you receive a request to prepare a new form, check to see if the new form duplicates or closely resembles a form already available. If it does, you should call the matter to the attention of your printing officer and see if arrangements can be made to use the existing form instead of preparing a new one. The forms control officer or the printing officer should approve all forms that originate in your command.

For further information on forms and forms design, you should refer to the *Forms Management Program Guidance*, OPNAVINST 5213.1 series.

SUMMARY

In this chapter we discussed in detail the different methods used for producing cold type composition. You were given information and shown the importance of copy placement. You also learned how to prepare direct image plates for reproduction. In later chapters, you will see how the actual job is produced with these lithographic plates.

We presented some of the most common cold type composing machines either as an introduction or in detail, depending on the machine's usage in lithographic shops. Since display type and photolettering machines are essential in producing cold type composition, we discussed these machines in depth.

Before working on any Navy equipment, the Navy Lithographer should refer to and study both the individual operator's manual and the related NAVSEA technical manual.

As a lithographer you should never forget the importance of proofreading. Proofreading skills are essential along with the ability to make corrections for job enhancement.

The principles of forms design were introduced primarily for LI1 and LIC candidates. Artwork preparation will be presented to the Navy Lithographer in the next chapter.

CHAPTER 4

ARTWORK PREPARATION

When preparing artwork for the camera, the Navy Lithographer might be required to use a variety of artwork forms. Artwork preparation means transforming the artist's concepts into a suitable form for reproduction. Any original artwork may be supplied to the Lithographer by an artist or a photographer, or it may be provided from another publication.

A lithographer must know the procedures used for preparing artwork for the camera and how to apply them. This chapter will discuss the types of artwork a lithographer might encounter, the equipment used, and the necessary skills needed to prepare the artwork.

KINDS OF COPY

All artwork falls into one of three general classifications: line, tone, or combination. (See fig. 4-1.)

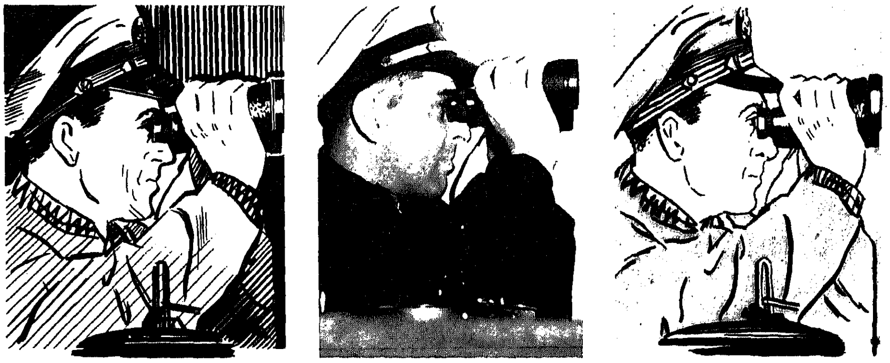
Line copy consists of composed material, reproduction proofs, clippings, lettering, pen-and-ink drawings, and any other artwork that will appear as lines or solid areas of color without gradations in tone. Negatives made from this type of copy are known as line negatives.

Tone copy consists of watercolor drawings, oil paintings, photographs, and other types of work composed of a series of tones that blend together. To preserve the shadows and tones found in tone copy, the camera operator must photograph it through a ruled screen. The screen breaks up the image into a series of tiny dots, like those shown in figure 4-1. These dots are so small that they blend together to give the appearance of continuous tone. A negative produced by this process is known as a halftone negative.

Combination copy, as the name implies, is art that consists of both tone and line work. An example of combination copy is a photograph to which lettering and lines have been applied. To reproduce the photograph as tone and the lettering and arrows as line, the camera operator must make two negatives—one for the line and one for the tone. These negatives are then fitted or stripped together to produce a combination image when the plate is produced.

LINE COPY

Line drawings ordinarily print only as lines and solid areas, but if shading is required, you can supply shading by such methods as cross-hatching with pen and ink or



LINE TONE COMBINATION

57.24

Figure 4-1.—The three general classifications of copy.

by sticking a sheet of patterned acetate over the area that is to be shaded. (See fig. 4-2.)

Preparing Line Drawings

Line drawings are generally prepared on white paper with black india ink. Dark blue and red ink will also reproduce fairly well, but pale colors such as light blue, gray, or yellow should not be used. Nor should original drawings be prepared on colored papers. If this colored paper photographs as black or gray, the camera operator will have difficulty separating the drawing from the background when making the negative.

The original drawing is usually prepared for one-half or one-third reduction. That is, it is drawn two times larger or one and one-half times larger than it will be when printed. When the negative is made, the camera operator then reduces the image to the proper size. Reduction minimizes flaws and gives the work a professional appearance.

When making a line drawing, you must keep all pen lines clear and open. If the master drawing will not stand reduction without a breakdown or filling in of lines and detail, you should make a smaller, more simplified drawing. (See fig. 4-3.) If you are going to use acetate shading sheets to shade areas, you must select a pattern that is coarse and open so that the dots or lines will not run together when the job is reduced.

When you are preparing a series of illustrations for a publication, you should draw the illustrations to the same scale, if possible. This will improve the appearance of the job and also save time in the camera room, since all the art can then be copied with the same camera setup. Lettering on all artwork throughout a publication should be carefully planned to assure uniformity in size after reduction.

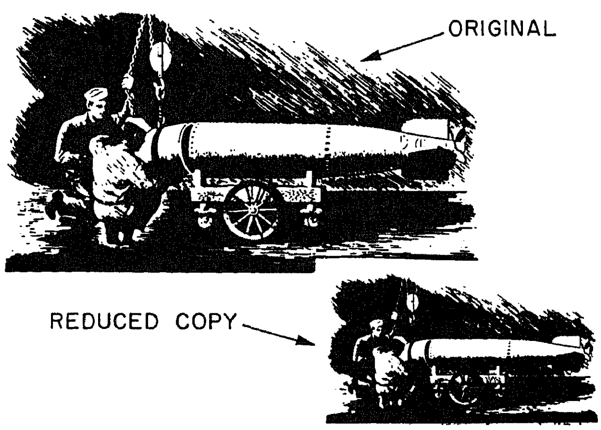


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Figure 4-3.—Resulting reduction of a poorly planned drawing. Here the lines on the original drawing are not clear and open, so they have run together when the original was reduced.

If the artwork is to be changed in size, you should mark the new width in picas in the margin of the copy, as shown in figure 4-4. If no reduction or enlargement is required, you can simply mark the copy *S/S* (same size) or *1:1* (one to one).

Most line copy is shot same size or smaller. Enlargement magnifies defects and gives line work a crude appearance.

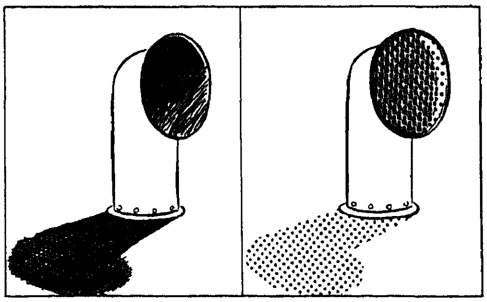

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Figure 4-2.—Methods of shading a line drawing. Crosshatching was used to shade areas in drawing on left. Mechanical shading was used on the right-hand drawing. The shading patterns were provided on sheets of waxed acetate which were applied to the original drawing and cut to fit the desired area.

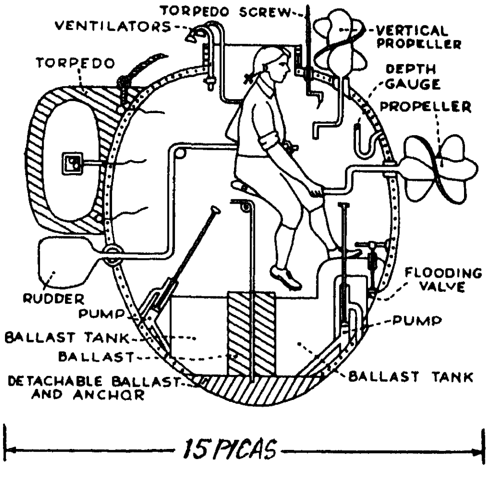

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Figure 4-4.—How to mark copy for size.

Line drawings should be mounted on illustration board. You may use lightweight paper for small drawings, but you should always use a heavier board for large drawings that require a good deal of handling. To facilitate handling, you should mount photographs of line drawings on cardboard and cover all artwork with a paper protective cover.

Techniques

There are various techniques used by artists in preparing line drawings. Some of these techniques you should become familiar with are shown in figure 4-5. A brief explanation of the figure is as follows:

Drawing A—Ordinary pen-and-ink work.

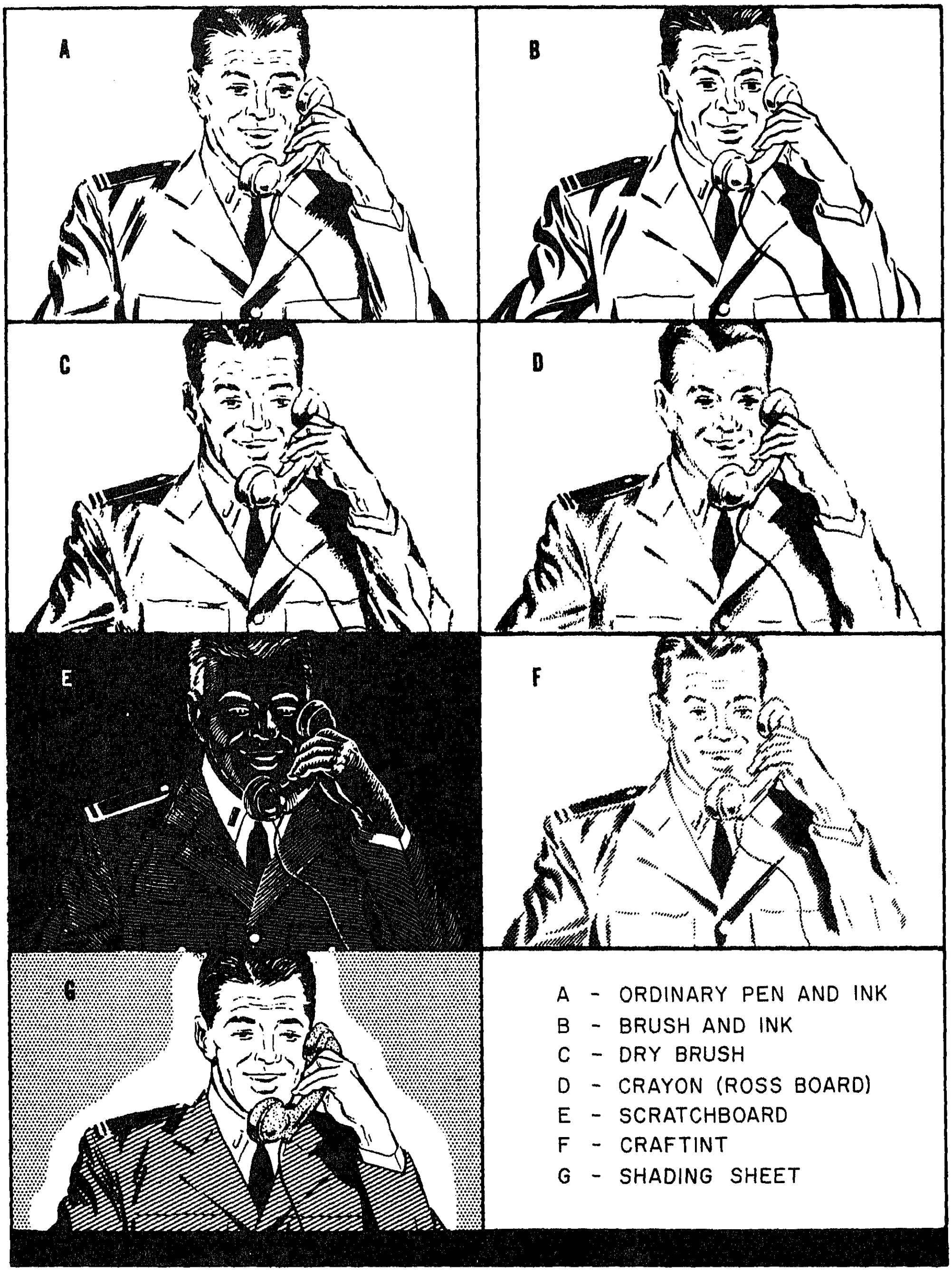

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Figure 4-5.—Line drawing techniques.

Drawing B—Brush and ink work.

Drawing C—Dry brush work. To prepare this drawing, the artist worked on rough paper and used very little ink in the brush.

Drawing D—Crayon work (Ross board). This type of drawing was done with crayon and ink on a special type of drawing board that has a pebbled surface. The little dots in this drawing give it a shaded effect similar to that produced by the acetate shading sheets. This illustration is known as a Ross board drawing, because Ross board is the trade name for the paper on which it was drawn. Drawings done on coquille board are similar in appearance.

Drawing E—Scratchboard work. Scratchboard is a type of drawing paper that has a smooth, clay surface. The artist first coats the paper with ink and then scratches highlights in the clay surface with a knife. This produces a woodcut effect.

Drawing F—Craftint work. The surface of this paper is chemically impregnated in an invisible line or dot pattern. The artist first makes a black-and-white line drawing on it in the regular manner and then brushes an acid developing solution on the areas that are to go in tone. The solution brings out the patterns or tones. Craftint papers come in single-tone or double-tone patterns. The double-tone patterns require two developers, one to bring out each pattern or tone.

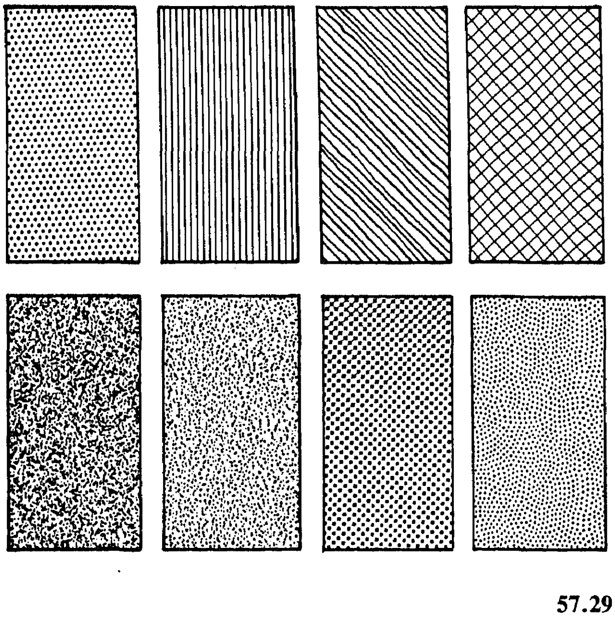

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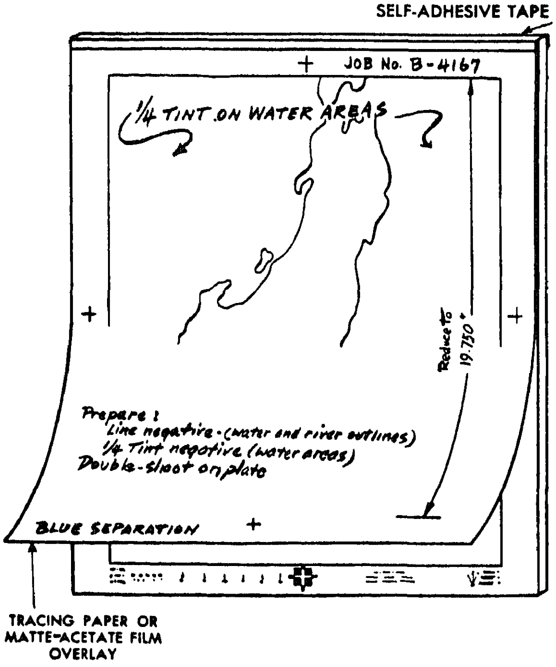
Figure 4-6.—Patterns available on acetate shading sheets.

Drawing G—Shading sheet work. Acetate shading sheets were used to produce this type of tone effect. These sheets are available in various patterns, as you can see in figure 4-6. They are waxed on one side so that they can be applied directly to the drawing paper. After positioning these sheets, the artist cuts along the edge of the tone areas with a knife and removes the trim. This process of applying the tone is generally referred to as *applying benday*. Benday is a generic term used for all tone effects. Some of these mechanical shading sheets are known by such trade names as Zip-a-Tone, Paratone, Art Type, and Visi-Type.

Shading sheets should not be applied to areas where the copy is dirty or patched over, because dirty or patched copy sometimes produces shadows or other defects when it is photographed. The defects can be painted out on the negative in open areas, but little can be done if the area is covered with a series of fine dots or lines. Therefore, if tone must be placed over patched areas, you should let the platemaker lay it. You should mark the area where the tint is to go with a blue pencil on a tissue overlay. A tissue overlay is simply a sheet of tissue paper that is taped to the drawing, as shown in figure 4-7. Overlays enable the artist


SELF-ADHESIVE TAPE
JOB No. B-4167
1/4 TINT ON WATER AREAS
Reduce to 19.750"
Prepare:
Line negative - (water and river outlines)
1/4 Tint negative (water areas)
Double-shoot on plate
BLUE SEPARATION
TRACING PAPER OR MATTE-ACETATE FILM OVERLAY

57.30

Figure 4-7.—Specifications and instructions written on overlays attached to cover original artwork.

to write instructions and specifications without marking on the copy.

The camera operator can produce tone on film by photographing a sheet of white paper through a halftone screen. These tone negatives are then superimposed on or stripped into the master negative in the areas indicated on the overlay.

Ruling Forms

Part of your work in the Navy will be ruling-in forms with pen and ink. You will be using draftsman's tools in this type of work. These tools include such items as a drawing board or drafting table, a T-square, plastic triangles and curves, a line gauge, a metal ruler, pencils and erasers, pens and ink, drawing and tracing paper, a compass, dividers, knives, razor blades, scissors, and rubber cement.

Drawing boards are generally made of pine or some other soft wood. The T-square consists of a long strip, called the *blade*, and a cross strip, called the *head*. (See fig. 4-8.) When the head is butted against the side of the drawing board, the blade is squared (at right angles) with the edge of the board. You can use the T-square when drawing horizontal lines and when squaring the work. You can also use it as a base for the triangle when you are drawing vertical and slanted lines.

Another useful device is the steel straightedge. It is essentially the same as the T-square except that it has no head. You may use it for drawing long, straight lines, but it is primarily intended as a guide when you are cutting with a knife.

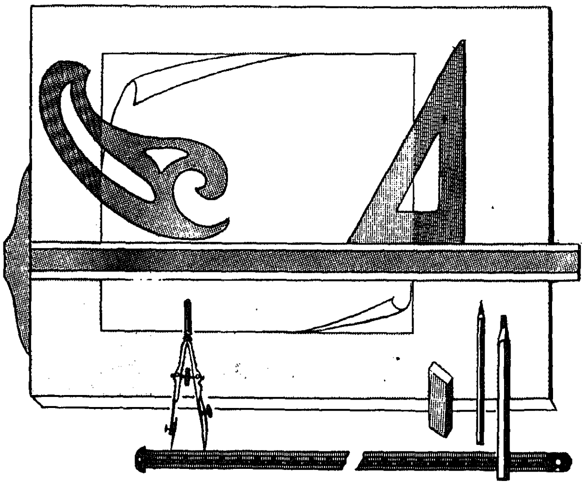


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Figure 4-8.—Draftsman's tools.

NOTE

You should never use a knife or razor blade with plastic drafting tools.

Plastic triangles, like the one shown in figure 4-8, are used for drawing vertical and slanted lines. To draw a vertical line, you simply move the T-square to the proper horizontal position and then place the base of the triangle against the blade. You can then draw the vertical line along the side of the triangle.

French curves are composed of a series of curved sections and are used for drawing all sorts of noncircular curves. When one of the curved sections matches exactly the curved line that you wish to draw, you can draw your line by simply tracing around the curved area. But more often, you will have to fashion your curve by shifting the guide as you go along.

You can use the compass for drawing circles and arcs. Some compasses have interchangeable parts, and you can use the same instrument for either pencil or ink drawings. Ink compasses are handled much the same as a ruling pen.

Dividers are similar to compasses except that both legs of the dividers have needlepoints. Dividers are used for transferring measurements and for dividing lines into equal parts. In layout work, dividers are especially useful in centering headings and checking margins.

Drawing pencils range from 2B (soft and black) through HB (medium) to 9H (very hard). You can use soft pencils, such as 2B or 3B, for making heavy, thick lines, but you should use hard pencils for making guidelines and writing in instructions. Drawing pencils do not have erasers. Art gum or kneaded gum erasers are generally used for making corrections and for cleaning smudges and dirt from the surface of the drawing paper.

Because red and black photograph better than other colors, most artists use light blue pencils when making preliminary and base drawings. The light blue pencils are used because light blue lines do not need to be erased after the sketch has been inked in—they will drop out during the photographing operation.

Tracing paper is a thin, tough, semitransparent paper and is available in pads or rolls of varying sizes. The artist generally prepares rough layouts on tracing paper and then transfers these layouts to the regular drawing paper where they are used as a basis for the finished art.

Ruling pens are used for ruling lines of uniform widths and should never be used for freehand work. They should be used with T-squares, triangles, and other guides. A ruling pen, shown in figure 4-9, will produce lines of various widths, depending on the set of the thumbscrew which separates the blades of the pen or brings them together. To fill the ruling pen with ink, you should use the dropper in the top of the ink bottle. (Do *not* place the ruling pen in the bottle of ink.) Put ink between the two points of the pen and keep the outside wiped clean to prevent the ink from running. Always keep your ruling pen clean when it is not in use. A dirty pen will produce a ragged line.

When you are drawing with the pen, it should be held so that the setscrew is away from you. The pen should be almost upright with a slight tilt in the direction you are drawing.

If you should be required to draw up a ruled form, square the sheet on the drawing board or table, using the T-square. Then fasten the paper to the board with draftsman's masking tape, a brown crinkly paper that peels off readily without damaging the surface of the drawing paper.

Pencil in outlines lightly, using the T-square for all horizontal lines and the triangle for all vertical lines. After the outline has been carefully laid out in pencil, go over it with the ruling pen. Once the form has been inked in, you can remove the sheet and type in the copy. Of course, if you prefer, you can type the copy on a separate sheet of paper and cut it out and paste it into place after the boxes have been inked in. You may also type the copy on the sheet before you rule in the form.

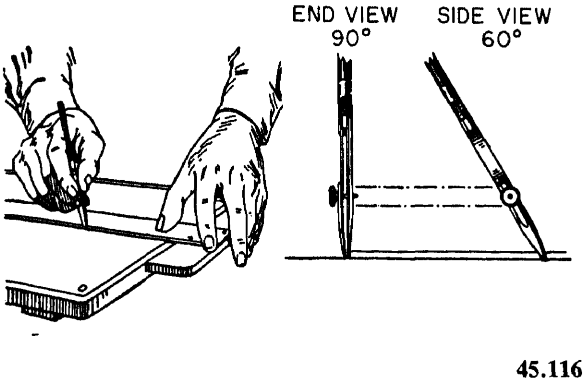

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Figure 4-9.—Ruling pen.

For further information regarding line drawings or the use of the ruling pen, study the Navy rate training manual *Illustrator Draftsman*, NAVEDTRA 10472.

Line drawings are not as critical as tone copy. In halftone work, every smudge, brush stroke, paste-up shadow, or fingerprint might show up in the negative. But in line work, only the blacks will print. Shadows and other defects will be eliminated (burned out) during photographing, or they can be opaqued (painted out) afterward on the negative, provided they do not fall within tone areas.

TONE COPY

You have seen how an artist can add flat, gray tones to line drawings by using shading sheets. The shading sheet dots or lines print as solid and are just as black as the darkest portions of the copy. But since they have white space around them, they look gray. (The eye mixes the white with the black and subdues its color.) Printers rely on this optical illusion for producing tints and tones in single-color printing.

The benday shading process produces flat, gray tones because the dots are all the same size. (See fig. 4-10.) As you can see in the bottom of the illustration, if some of the dots are made larger than the others, they will appear darker. This is because the larger dots cover more of the paper and there is less white space between them. The halftone process is based on this principle.

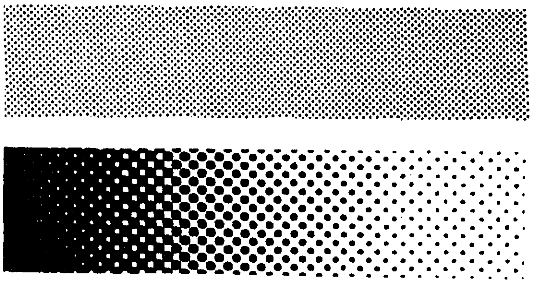

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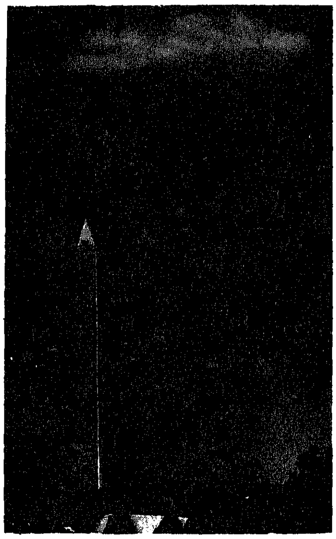
Figure 4-10.—Tones produced by a series of dots. The tone above looks flat or even because all the dots are the same size. The bottom tone looks darker on the left side because the dots on that side are larger than the others and have less white space between them. Halftones are composed of dots of varying sizes.

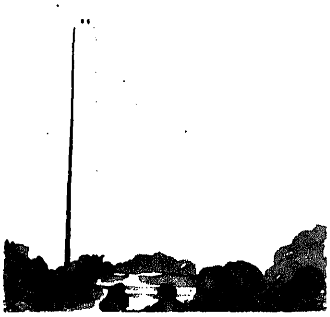
To get the full range of tones from a photograph, you must break the entire photograph into a series of dots. These dots must be of varying sizes so that some areas of the photograph will appear darker than other areas.

The camera operator breaks the copy into dots by photographing it through a screen that has a series of crosslines. These crosslines form a pattern that breaks up the light as it passes through the camera. The broken light registers on the film as a series of small individual dots, each varying in size according to the amount of light being reflected from the copy at that particular point. Like the benday shadings, these dots blend together to produce an overall gray tone. But since these dots are of varying sizes, they produce a series of tones ranging from light gray to black.

Besides photographs, tone copy includes drawings rendered in pencil, crayon, charcoal, wash, watercolor, tempera, oil, and airbrush. Figure 4-11 shows some illustrations produced by some of these media.

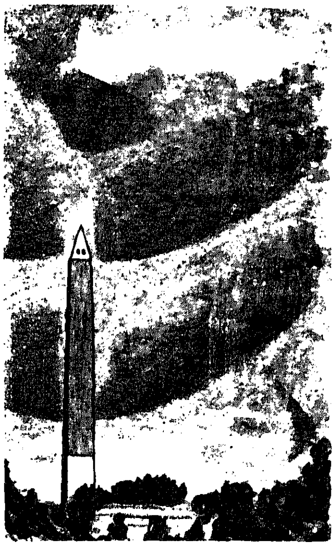


PHOTOGRAPH

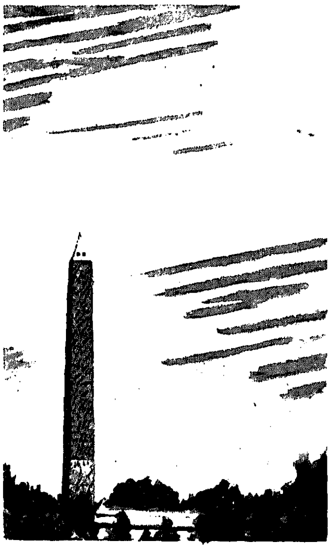


WASH

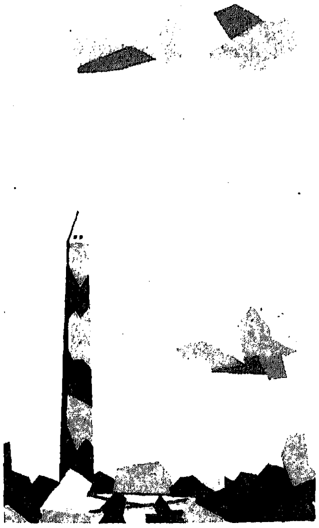
TEMPERA



CHARCOAL



OIL



AIRBRUSH

57.32

Photographs

Photographs should be sharp and clear. Glossy photographic prints reproduce better than dull (matte-finished) prints. Blurred and faded prints will not reproduce well and should not be used. The lithographic camera operators requirements for quality of tone copy and photographs are similar when reproduction is required.

RETOUCHING.—Retouching photographs is often necessary to bring out the details desired, to paint out objectionable backgrounds, or to heighten contrast between blacks and whites.

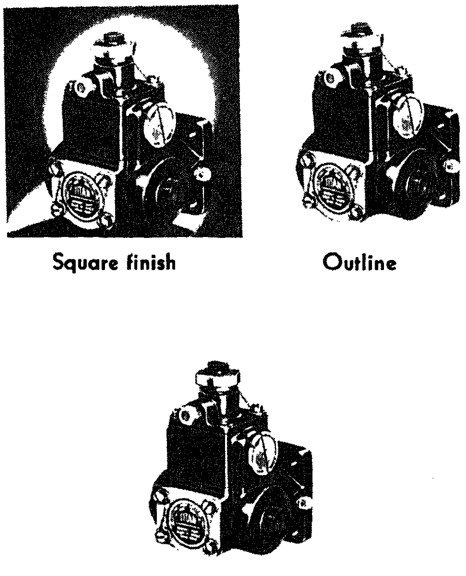
Retouching is generally done with retouch watercolors and a regular watercolor brush. Retouch watercolors consist of seven shades of gray as well as Chinese white and lampblack. You should mix the watercolors to match the color of the photograph. The colors should tend toward brownish rather than bluish tones.

If the surface of the photograph is not receptive to watercolors, you should rub it with a piece of cotton and a powder called fuller's earth.

Retouching must be done with the camera work in mind, since coarse halftone screens call for greater contrasts of light and shade. If the camera operator uses a fairly coarse screen when copying an original, the dots will be large and part of the detail will be lost. Therefore, you needn't worry about faint brush marks, since they will be lost in screening. But if the screen is fine, the brush marks might show up in the finished job. With a little experience, you will be able to tell what will reproduce and what will not.

Halftones produced from retouched photographs are generally designated as square finish or outline. (See fig. 4-12.) Square finish halftones are the conventional square or rectangular forms that are used in everyday work. Outline halftones are those in which the background has been cut away or eliminated. The vignette is another type of finish that has soft, feathered outlines that blend into the surrounding white space of the pages. Although they were once very popular, vignettes are seldom used today.

MOUNTING.—Photographs should never be rolled or folded. They should be mounted on stiff cardboard or illustration board in a photographic dry-mounting press. If a dry-mounting press is not available, you can use rubber cement to mount all the photographs except Polaroid because rubber cement will damage them. Certain types of glue will also damage photographs after a period of time. You can use wax to mount all types of photographs, provided your shop is equipped with a waxing machine. After they are mounted, all photographs should be protected with a paper cover flap. You can attach the paper to the back of the cardboard and fold it over the face of the illustration.


Square finish

Outline

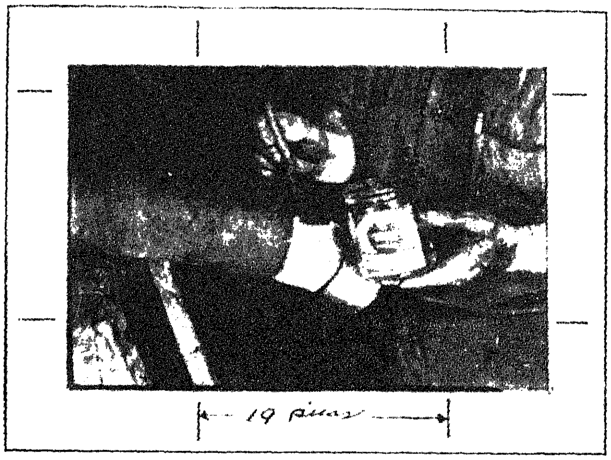
Vignette

57.34

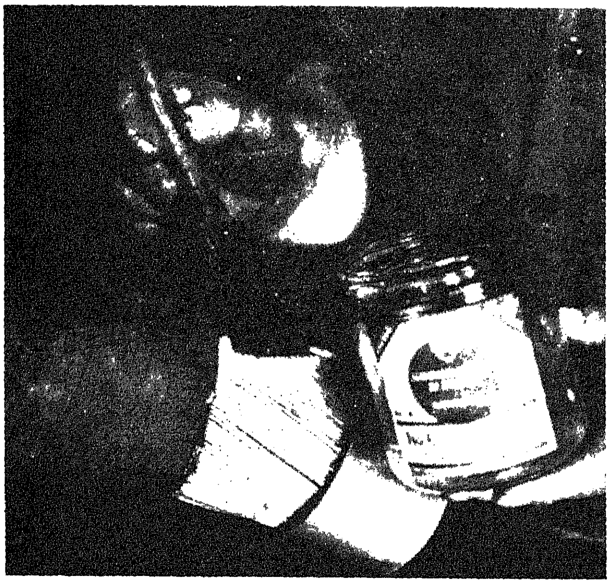
Figure 4-12.—Halftone finishes.

CROPPING.—When you want to reproduce only a portion of a photograph, you should crop (mark off) the unessential parts. You can mark the margins of glossy prints with grease pencil or ink. (See fig. 4-13.) Some camera operators prefer copy that has been marked with ink, since the grease tends to come off on the glass of the copyboard when the job is photographed. You may also indicate the section of the picture to be used by outlining it with Chinese white, as shown in figure 4-14. Grease pencil marks can be removed with a dry cloth or an eraser. Chinese white may be removed with a damp cloth. But it is difficult to remove ink marks completely. You can, however, lighten them with a damp cloth or eraser, or you can cross them out with new markings if you need to reuse the photograph.

When a section of a valuable photograph or matte-finish print is to be reproduced, you may mask it off by covering the whole picture with a sheet of paper and cutting a window to expose the



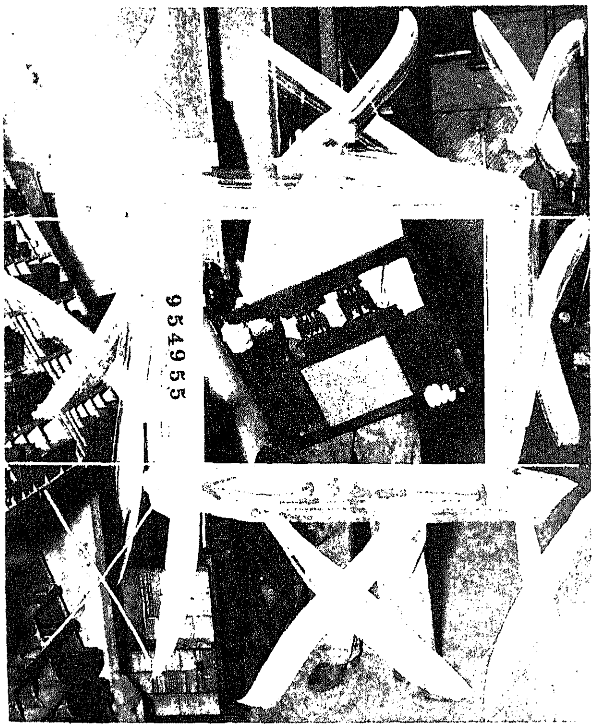
PHOTOGRAPH BEFORE CROPPING. CROP MARKS ARE MADE IN THE MARGINS OF THE COPY TO INDICATE TO THE CAMERA OPERATOR THE AREA TO BE USED.



PROOF FROM NEGATIVE MADE FROM CROPPED PHOTOGRAPH.

57.35

Figure 4-13.—How to crop a photograph.



57.36

Figure 4-14.—Photograph cropped with Chinese white outline.

desired area. If the photograph is to be reduced or enlarged, the exact width must be marked in picas in the margin of the copy. Likewise, same-size photographs should be marked *S/S* or *1:1* in the margin.

SCALING.—The same system that you use to scale copy for reduction may be used for scaling photographs. You must always remember that when the width of the photograph is increased or decreased, the height is also increased or decreased proportionately. When you know the width, you calculate the new height by using the following formula:

$$\frac{\text{original width}}{\text{increased or decreased width}} = \frac{\text{original height}}{\text{increased or decreased height}}$$

Suppose you wish to reduce a piece of copy that is 3 inches wide and 6 inches deep to fit a space that is 2 inches wide. To find the new height, you simply substitute the figures in the formula:

$$\frac{3}{2} = \frac{6}{X}$$

Cross-multiplying, you get

$$3X = 12$$

Then divide to find the final value of X

$$X = 4$$

Therefore, your new height will be 4 inches.

Scaling may also be done with a scaling wheel (circular slide rule) or any other of the many patented devices available. Instructions for using these devices are usually printed on the face of the dials.

Tone Drawings

Tone drawings are generally prepared for one-half or one-third reduction. In preparing tone drawings, you should use the same rules for scaling, marking, and so on, that you use in working with photographs.

Tone drawings should be crisp and sharp. If they are flat and lacking in strength, they will not reproduce with quality. Wash drawings are generally done with lampblack and water on a white drawing paper having a slightly textured surface.

It is better not to do drawings for black-and-white reproduction in colors—especially showcard colors, because these colors usually appear muddy and photograph as either too dark or too light.

Colored photographs, oil paintings, and pastel drawings are difficult to copy for black-and-white reproduction because the colors do not photograph true. Film emulsions are more sensitive to some colors than they are to others; consequently, some colors photograph too dark while others photograph too light. To help balance or alter the colors, the camera operator often photographs colored copy through a filter. A filter is a disk (or square) of colored glass, gelatin, or acetate which makes some colors photograph darker and others lighter than the original copy.

Crayon drawings generally give good reproduction. Charcoal and pencil drawings are sometimes difficult to copy if they lack contrast.

Clippings

When original drawings are not available, glossy photographs of original drawings may be used as copy. Clippings or photographs of clippings of previously screened halftones may also be used. If the halftone dots in the clipping are coarse, the camera operator may be able to copy the clipping as a line shot. But if the original screen was fine and the dots are indistinct, the clippings should be rescreened, and the copy should be marked *halftone*. Clippings never reproduce as well as the original copy. When clippings are rescreened, the dots from the old screen often overlap the new dot formation, forming a disturbing pattern called moire.

If the clippings have been printed in color or on colored paper, you should consult your camera operator before submitting them. The camera operator may decide to reproduce the color by photographing it through a filter. In some cases, the filter will cancel out the background color, making it photograph as white. In other cases, it will not be possible for the filter to separate the background from the copy, and you will need to make a new drawing in black and white.

If you use sharp, glossy photographic prints of original line drawings or clippings as copy, it may be necessary to retouch these photographic prints with ink or with black and white watercolors. Smudge marks and fuzziness may be painted out with Chinese white, and broken or grayed areas may be sharpened and filled in with india ink.

By photographing a clipping, you can produce a line drawing by tracing over a photograph with pen and ink. Then the photographic image should be bleached out so that only the inked lines remain. You can also use a mechanical tracing instrument known as the pantograph for producing line drawings from photographs. The pantograph is also often used for enlarging or reducing artwork drawings.

Transparencies

A transparency is a photograph printed on glass or film, sometimes in color and sometimes in black and white. Transparencies have wide use in color separation work, but they are used less often as copy for black-and-white reproduction. To make a negative from a transparency, the camera operator places the transparency in direct contact with the emulsion side of a piece of film and exposes the two to a weak, diffuse light. Transparencies may also be placed in a light box and copied with the camera.

COMBINATION COPY

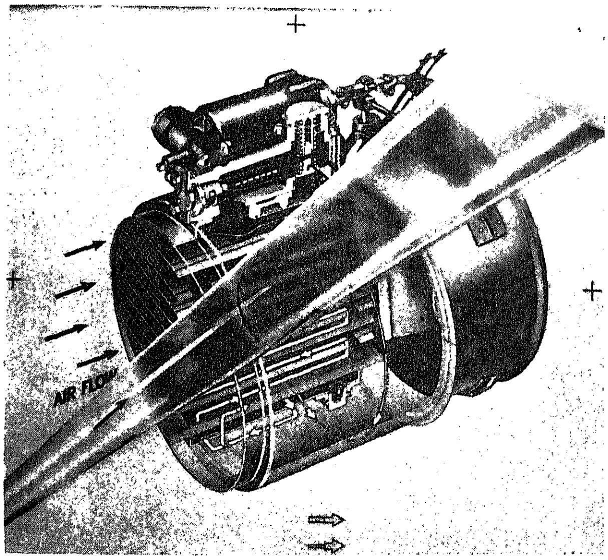
When lettering or other line work is to be combined with a photograph (or any kind of tone drawing), you should first mount the photograph on a piece of illustration board, as previously described. You can then cut out the type and paste it directly on the photograph, or you can attach an acetate overlay to the photograph and paste the type on the overlay. (See fig. 4-15.)

Pasting the type directly on the photograph is more economical than the overlay method because it enables the camera operator to shoot the entire job as a straight halftone. However, there are two disadvantages to pasting the type directly on the photograph.

1. The lettering in the finished cut is likely to be fuzzy and indistinct, since it will be broken up by the halftone screen.
2. Shadow lines around the pasted-up areas may appear in the finished illustration, and there is no way to remove these shadows.

Therefore, when you want quality, you should prepare your line copy on the acetate overlay and mark the job *surprint* (here to mean one image is superimposed on another).

When lettering or artwork is done on an overlay, the overlay should be keyed to the photograph (master) with register marks to aid in proper positioning. The crop marks may be traced onto the overlay to serve as register marks, or standard register marks (+) may be applied in the margins of both the photograph and the overlay. (See fig. 4-15.)



57.38

Figure 4-15.—Line copy prepared on an acetate overlay for a combination job.

Clippings or photographs of printed combination work may also be used as copy. They may be shot as regular halftones or as combination work, depending on the effect desired.

SPECIAL EFFECTS

You may inject additional interest into a page by using oversize or bleed illustrations, insets, or combinations of tone and line.

BLEEDING

A bleed illustration is one that has no margin of white space between it and the edge of the paper. In other words, it runs off the page. An illustration may bleed on all sides, or it may bleed only on one, two, or three sides.

When an illustration is to bleed, it must be marked so that after any change in size, the illustration will be at least 1/8 inch wider and higher than it is to appear after the page has been trimmed. Since some of the illustration will be cut off when the page is trimmed, you must see that nothing important (such as a name on a map) comes too close to the edge of the copy.

Since bleed illustrations usually require larger paper stock and need considerably more care in production, they are more costly and are seldom used in Navy publications.

INSETS

An inset is a small picture inserted into a large one. To make an inset, you should crop the larger picture to indicate the area where the inset is to go by rubber-cementing a piece of black paper (the size of the inset) to the larger photograph. This will produce a transparent area in the negative of the larger photograph, which will enable the stripper to position the inset visually. If the inset is to be enlarged or reduced in size, you must scale it accurately so that it will fit the space allotted. Attach a tissue overlay sheet to the photograph and write on the overlay exact instructions for the camera operator and stripper.

REVERSE COMBINATIONS

To reverse the type so that white will result with a black background, as shown in fig. 4-16, you should mount a good, sharp composed line of paste-up lettering of the desired typeface on a sheet of stiff drawing paper; draw a border in red ink to indicate the dimensions of the black area. Then instruct the camera operator to make a positive from your copy. This positive is then placed over the negative in the stripping process prior to platemaking so that the desired area of the plate will not be exposed. Thus, the unexposed area will leave the lettering white on the printed sheet.

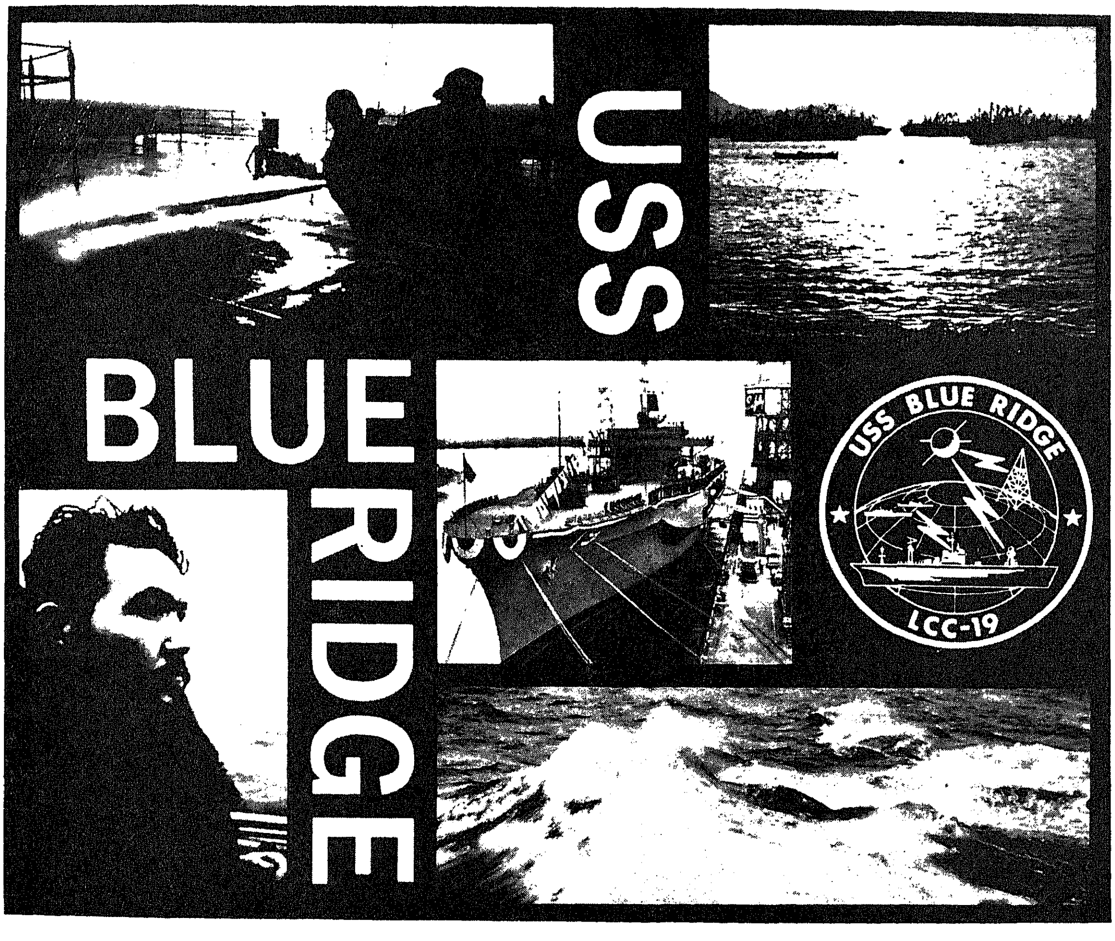
Reverse combinations can also be made on shaded or photographic backgrounds, as you can see in figure 4-16. Reverse combinations may be enlarged or reduced, if necessary, during the copying process.

COLOR WORK

As a Navy Lithographer, you will probably not be doing much color work. However, you should become familiar with the processes used for preparing copy for color reproduction.

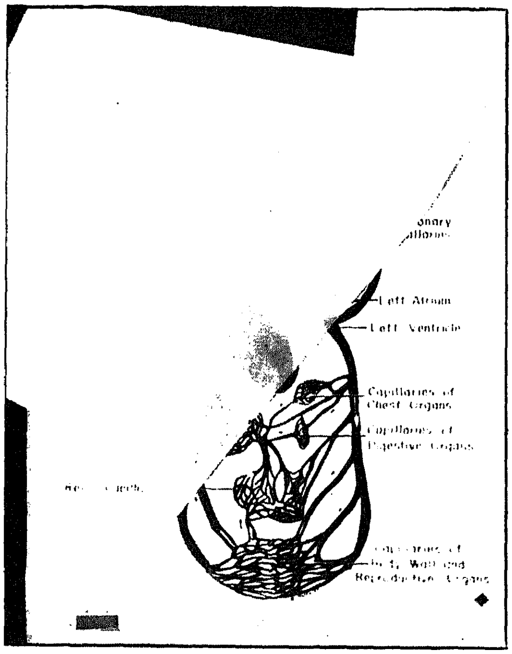
Methods of preparing line copy to be printed in color are shown in figures 4-17 through 4-19. A simple black-and-white drawing is all that is required if the colors are not to overlap. To guide the camera operator in making the color separation, you should attach a tissue overlay to the original drawing and, using colored pencils, fill in on the tissue all the areas that are to be in color.

The camera operator will then shoot as many negatives from the original as necessary to reproduce all the colors desired. Then, using the

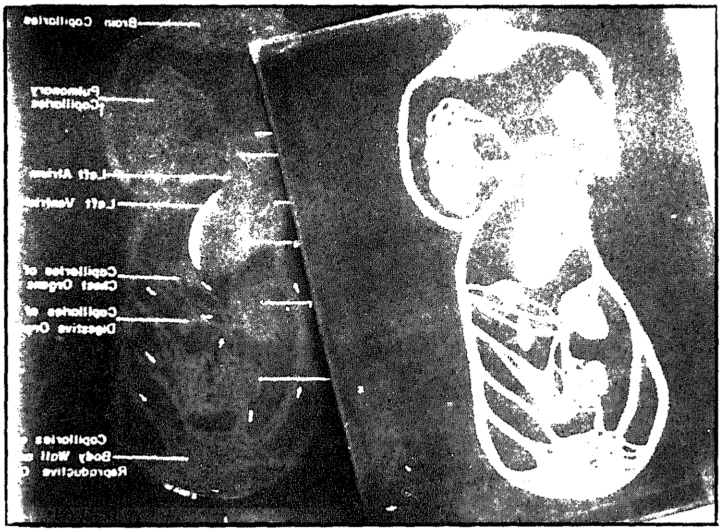


57.705

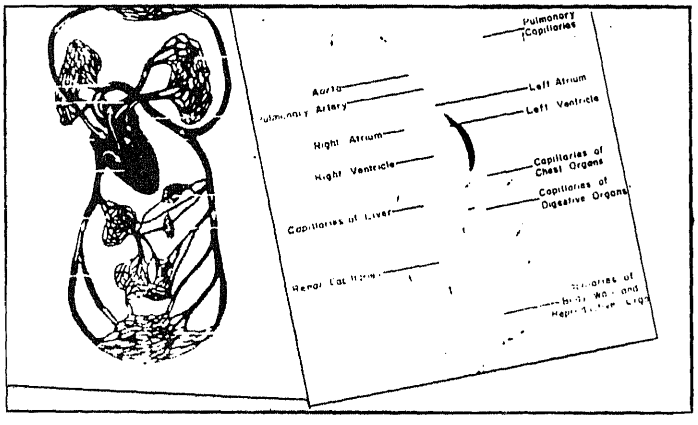
Figure 4-16.—Example of reverse combinations.



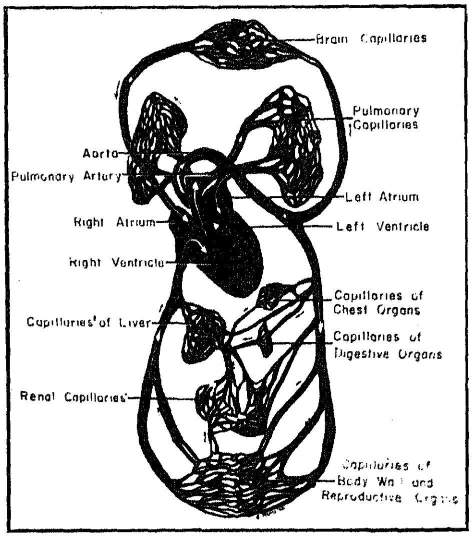
WHEN COLORS DO NOT OVERLAP, THE CAMERA OPERATOR CAN MAKE LINE-COLOR SEPERATIONS FROM A SIMPLE BLACK-AND-WHITE DRAWING. TO GUIDE THE CAMERA OPERATOR IN MAKING THE SEPERATIONS, YOU SHOULD ATTACH A TISSUE OVERLAY TO THE ORIGINAL DRAWING AND FILL IN ON THE TISSUE WITH COLORED PENCILS THE AREAS THAT ARE TO GO IN THE SECOND COLOR.



THE CAMERA OPERATOR WILL THEN SHOOT TWO NEGATIVES FROM THE ORIGINAL DRAWING AND USING THE OVERLAY AS A GUIDE, WILL MASK OUT ON EACH NEGATIVE ALL AREAS THAT ARE NOT TO GO IN THAT PARTICUALR COLOR.



THE PROOFS FROM THE RESULTING PLATES WILL LOOK LIKE THIS.



THE RESULTING TWO-COLOR JOB WILL LOOK LIKE THIS.

57.39

Figure 4-17.—How line-color separation may be made for a simple black and white drawing. Original drawing should carry register marks.

overlay as a guide, the camera operator will make the color separations by masking out on each negative all areas but those that are to print in one particular color. From these masked-out negatives, the plates for each color can be made.

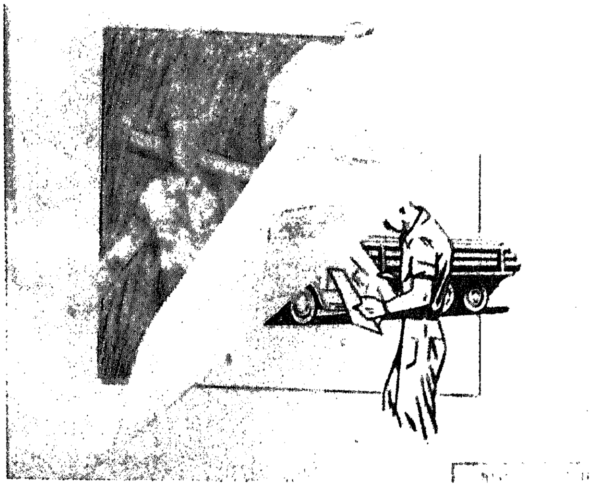
COLOR BLOCKS AND TINT AREAS

The background area generally consists of solid color blocks or tints. These color areas may be filled in with india ink on the original drawing, or you may simply indicate where they are to go by outlining the area on the original drawing with red ink. You should then shade in or block in the area on a tissue overlay, as shown in figure 4-18.

The camera operator will then make two negatives, masking out parts of each to produce the color separation plates. When you ask the camera operator to supply a tint, always indicate on the overlay or on the original art the tone value required. A 25 percent tint means 75 percent of the area will be left as white space. As a rule anything below 25 percent is rather light for color work, especially if the tint is to be printed in a light color of ink.

COLOR OVERLAPPING

If the colors are to overlap, you should make a key drawing in black (the main color) on a sheet of white illustration board. Then attach an acetate overlay to the key drawing and draw on the acetate the parts that are to print in the second color. If the job is to be run in more than two colors, use a separate acetate overlay for each additional color. (See fig. 4-19.) If acetate is not available, you can use tracing paper as an overlay. However, tracing paper is not as suitable for this purpose because it tends to wrinkle when ink is applied to it.



57.40

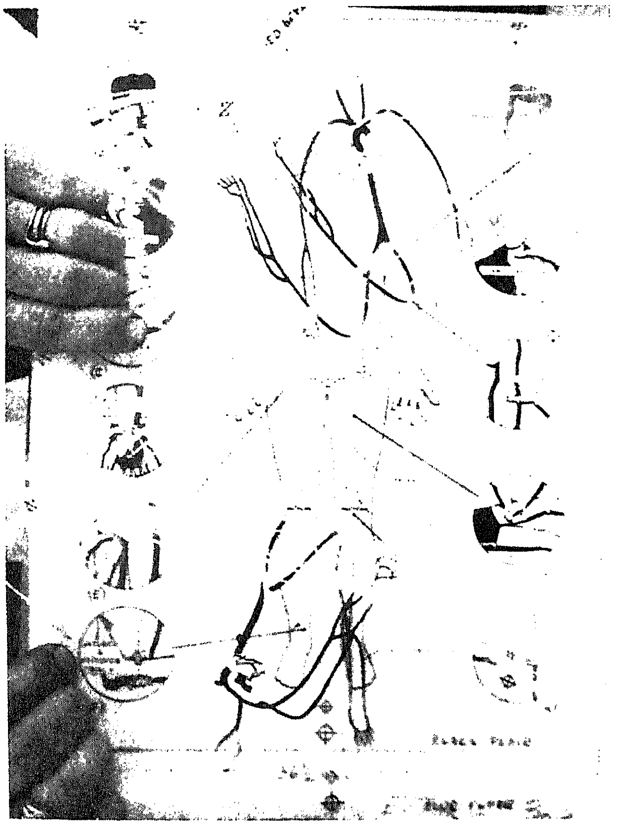
Figure 4-18.—How the artist indicates areas for color blocks and tints. In illustration shown here, black and white copy

RULES COVERING COLOR WORK (NAVSO P-35)

Guidelines and regulations for both authorized and unauthorized types of color printing are outlined in the *Department of The Navy Publications & Printing Regulations*, NAVSO P-35. Because of the relevance of this publication, Navy Lithographers at all paygrades should study it.

PASTE-UP

Cold type composition, photocomposition, and paste down lettering may be used in preparing text and headline copy for lithographic printing. Before you send the copy to the camera operator, it is a good idea to assemble the copy and paste it up as a complete page or unit.



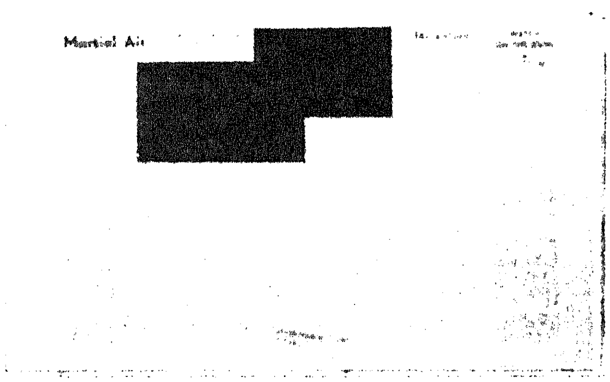
57.41

Figure 4-19.—Illustration showing how artwork is prepared for a job when the colors overlap. The base drawing is

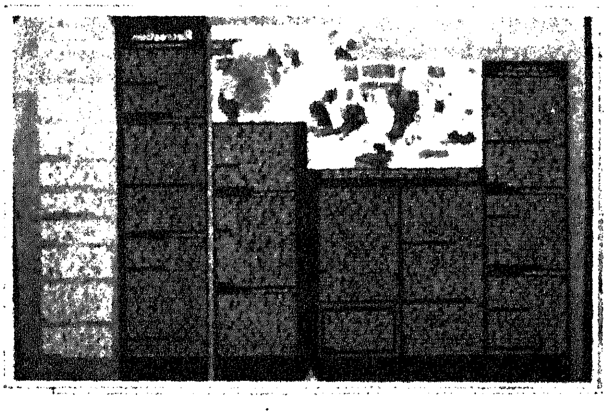
When facilities permit the use of composing machines, a page form should be composed in its finished form. Rules, borders, and heads should all be included, but the artwork may be omitted. Blank spaces should be left in the composed page where the art is to be placed.

Typed originals may be used as the master copy for the camera operator. You should mount the typed originals on heavy cardboard and then touch up imperfect letters with india ink and Chinese white. Next, mount all line drawings that do not require enlargement or reduction in the blank spaces on the master copy. You should not mount illustrations that are to be enlarged or reduced or illustrations that are to be shot as halftones. These illustrations require different camera setups; therefore, they must be photographed separately and stripped into the master negative.

When illustrations are to be enlarged, reduced, or shot as a halftone, you should mask out on the master copy the areas where these illustrations are to be placed. You can do this by pasting black paper over the areas, as shown in figure 4-20.



MASTER COPY. THIS ONE CONSISTS OF REPRODUCTION PROOFS. NOTE MASKED-OUT AREAS FOR HALFTONE ART AND PASTED-UP LINE DRAWING AT TOP OF "WATCH ON THE BRINE" COLUMN. IF THE OFFSET PLATE IS LARGE ENOUGH IT IS A GOOD IDEA TO LAY OUT YOUR PASTE-UP COPY IN TWO-PAGE FORMS.



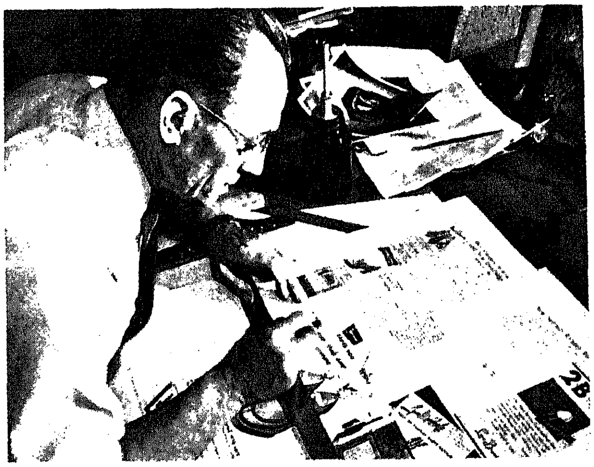
MASTER NEGATIVE MADE FROM ABOVE COPY. HALFTONES AND BENDAY AREAS HAVE BEEN STRIPPED IN.

Then attach a tissue overlay to the master copy and indicate on the tissue which illustration is to go in each masked area.

When the master copy is photographed, the masked portions will show up on the negative as *windows* or transparent areas. The tone work is then shot separately, and the line drawings are shot to the proper scale. The negatives thus produced are then stripped into the master negative, as shown in the illustration. Stripping, in this case, consists of placing the *strip-in* negatives or inserts into the proper windows on the master negative and securing them with strips of red cellulose tape. Figure 4-20 shows a master negative after it has been stripped up.

SPECIAL EQUIPMENT/SUPPLIES FOR PASTE-UP

Sometimes, when cold type composition is used as copy, paste-up work is more involved. In some cases, you must rule up a sheet of heavy stock with a T-square and blue pencil to show the typed area, trim size, bleed, and column widths. Always use a light blue pencil for preliminary ruling because the blue lines will drop out when the copy is photographed. Before pasting up the sheet, you should go over the blue lines with a ruling pen and india ink to supply those column rules, borders, and other elements that you wish to retain. Then carefully trim the copy to column size and mount it on the layout sheet with rubber cement. Use the T-square to align the columns. (See fig. 4-21.)



57.44X

Figure 4-21.—Pasting up a page of cold type composition.

If the cold type composition has been prepared on a larger scale so that it can be reduced when it is photographed, the entire layout must be enlarged proportionately. Reducing the width of the line also reduces its height. Therefore, the layout must be made longer as well as wider than the job is to be when it is printed.

> Remember: The method of scaling for enlargement or reduction was discussed in chapter 3.

Headlines may consist of reproduction proofs, lines composed on a photo-lettering machine, or paste-up letters. Headlines may be pasted directly onto the master layout unless they are to be enlarged or reduced. Same-size line drawings may also be mounted on the original layout, but tone work and line drawings that require reduction or enlargement must always be mounted separately.

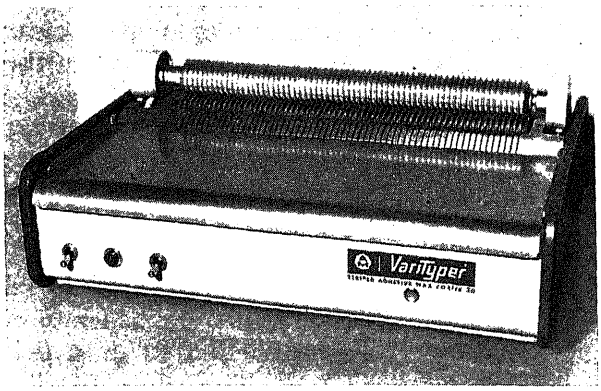
Rubber Cement/Wax

Always use rubber cement or wax for pasting up copy. NEVER USE GLUE! Rubber cement, which is actually rubber dissolved in a solvent, should be of the proper consistency to adhere to the paper surface without penetrating or staining it. If the cement is too thick, you can thin it with cement thinner. Rubber cement is flammable! Never dry it with excessive heat or over an open flame.

Rubber cement has certain characteristics that make it especially suitable for paste-up work. It is tacky enough to hold the copy in place, yet it doesn't set hard like glue. You can peel the copy up and reposition or remove it if necessary without a great deal of damage or effort.

You can apply rubber cement to the back of the copy and position the copy on the illustration board before the cement dries, or you can apply the cement to both the copy and the drawing paper and allow both to dry before positioning the copy. You will find that dried rubber cement surfaces still have an affinity for each other. Attach one corner of your copy to the illustration board and then align it with the T-square before pasting it down.

After the copy has been mounted, you should clean up the layout with a ball of dried rubber cement and an art gum eraser. The ball will pick up the excess rubber cement and the eraser will remove smudges and dirt.



57.581

Figure 4-22.—Waxing machine.

Wax has several advantages over rubber cement. It is quicker to apply, and if you mount the copy in the wrong place on the layout, it is easier to move.

Waxing Machine

The waxing machine, shown in figure 4-22, should be turned on at the beginning of each workday and turned off at the end of the workday. As soon as it heats sufficiently to melt the wax, it is ready for use. Copy is fed face-up between two rollers on the machine. The lower roller carries the wax and waxes the back of the copy. The waxed copy can then be mounted.

In addition to the waxing machine shown in figure 4-22, there are small hand waxers available, which are handy for small quantities of work.

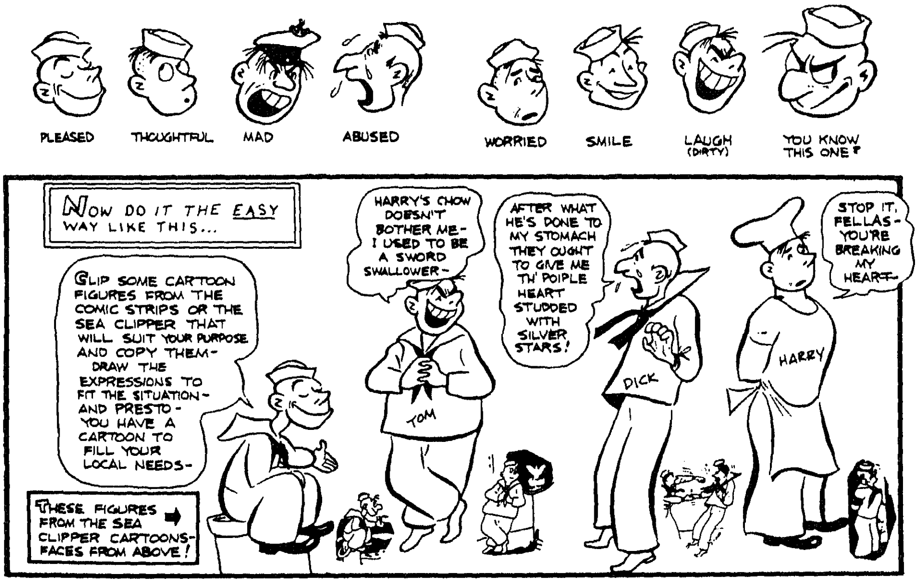
INSTRUCTIONS TO THE CAMERA OPERATOR

Before sending artwork to the camera operator, you should review it carefully to see that all instructions are clear and concise. Be sure that all crop marks are plainly indicated and that all illustrations have been properly scaled and marked for size. In the case of full-page illustrations, be sure there is enough space for the legend or cut line at the bottom of the page.

REFERENCE MATERIALS

This chapter has covered the mechanical or production end of the preparation of artwork for offset reproduction. This chaper makes no attempt to tell you how to draw. Artwork is a specialty in itself. Artwork preparation requires considerable training and practice.

But whether you are an artist or not, you can clip artwork from various Navy publications. You can use the artwork in its original form, or you can modify it slightly to serve your needs. (See fig. 4-23.)


PLEASED
THOUGHTFUL
MAD
ABUSED
WORRIED
SMILE
LAUGH (DIRTY)
YOU KNOW THIS ONE?
NOW DO IT THE EASY WAY LIKE THIS...
CLIP SOME CARTOON FIGURES FROM THE COMIC STRIPS OR THE SEA CLIPPER THAT WILL SUIT YOUR PURPOSE AND COPY THEM- DRAW THE EXPRESSIONS TO FIT THE SITUATION- AND PRESTO- YOU HAVE A CARTOON TO FILL YOUR LOCAL NEEDS-
THESE FIGURES FROM THE SEA CLIPPER CARTOONS- FACES FROM ABOVE!
HARRY'S CHOW DOESN'T BOTHER ME- I USED TO BE A SWORD SWALLOWER-
TOM
AFTER WHAT HE'S DONE TO MY STOMACH THEY OUGHT TO GIVE ME TH' POIPLE HEART STUDDED WITH SILVER STARS!
DICK
STOP IT, FELLAS- YOU'RE BREAKING MY HEART-
HARRY

57.582

Figure 4-23.—How to adapt Navy illustrations to your needs.

You can also select illustrations from commercial magazines and newspapers, but you can only use the illustrations as reference materials, since they may be copyrighted. Do not paste-up illustrations and use them as copy for reproduction.

NOTE

You must never use copyrighted material without written permission.

All artists and layout personnel use the work of others as a source of inspiration, but the work they turn out is their own product; it is not a reproduction of the original.

SUMMARY

Artwork is classified as line, tone, or combination. Line drawings contain no tones or shades—only solid blacks and whites, like those found in pen-and-ink drawings. Tone work consists of copy, such as watercolor drawings and photographs, that contains graduated shading and intermediate tones. Combination art consists of both tone and line; for example, a photograph to which the lettering has been added.

The same camera is used for both line and tone work, but the photographing operation is slightly different. Tone work must be copied through a halftone screen, whereas line work is shot without the use of the screen.

Line drawings are generally prepared for one-half or one-third reduction. Lines should be clear and open so that they will not fill in when the drawing is reduced.

Shading may be introduced into line drawings by several methods. Benday shading sheets are most commonly used for mechanical shading, but there are also special drawing papers that may be used.

Tone drawings and photographs should be crisp and clear. Glossy prints are better than matte-finished photographs. Blurred and faded prints should not be used.

Photographs should be cropped and retouched to emphasize the most important details. To ensure that photographs will fit into the space allotted to them in the layout, they should be carefully scaled. Clippings, or photographs of clippings, may be used as copy when necessary, but they do not reproduce as satisfactorily as originals.

Oversize or bleed illustrations, insets, reverse lettering, reverse combinations, and combinations of tone and line can be used to inject special interest into a job.

When line drawings are to be printed in color, a simple black-and-white drawing will be sufficient if the colors do not overlap. If the colors do overlap, the part of the drawing that is to go in the second color should be prepared on an acetate overlay attached to the key drawing. A separate overlay is used for each additional color.

It is a good idea to assemble work and paste it up into the largest units possible before submitting it to the camera operator. All pieces of same-size line copy can be pasted together on a layout sheet, but line copy and tone copy that require enlargement or reduction must be submitted separately.

CHAPTER 5

PHOTOGRAPHIC EQUIPMENT

Before attempting to operate any camera and/or darkroom equipment, lithographers must have a general knowledge of light. Because light is important in the production of camera room and darkroom products (photographic film, negatives, and photographic prints), this chapter will provide general information on the characteristics of light and how the various colors in light may affect the work of a lithographer.

Although the type of photographic equipment in your camera room or darkroom determines somewhat the success of your printing job, the principles of photography used by the lithographer are very important.

Although the operations of lithographers and photographers are similar, they differ in that a photographer takes photographs and makes extra copies, whereas the lithographer may end up with thousands of copies after the shots have been printed.

THEORY OF LIGHT

Light that enters your eye can be either natural or artificial. Light seen by the eye is either direct from its source or reflected. And when light is reflected from an object, that object can be seen or photographed.

LIGHT

The sun, light bulbs, and even a flame are examples of light we can see being generated. We can also see nonluminous objects because they reflect light from luminous sources.

Later in this chapter, you will see how photographic equipment "sees" reflected light and how this reflected light is recorded for the lithographer.

A large volume of light is called a beam. A narrow cylinder of light is called a pencil. And the smallest portion of light is known as a ray. (Actually there is no such thing as a *single* ray of light; but for the sake of clarity and convenience, a straight line drawn to show the direction in which these rays of light travel is known as a ray.)

Light travels through the air at a speed of 186,000 miles per second in the form of electromagnetic vibrations or waves. As shown in figure 5-1, electric power waves, radio waves,

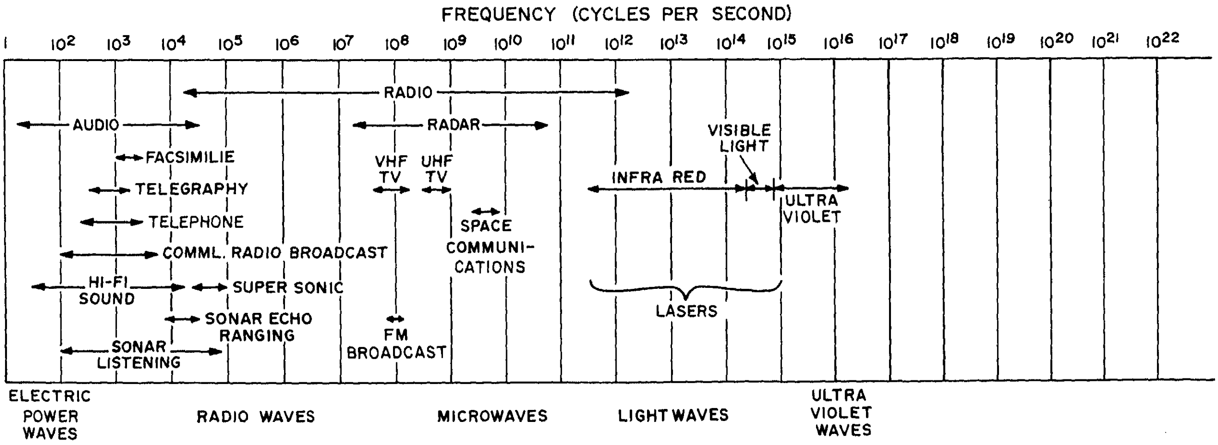


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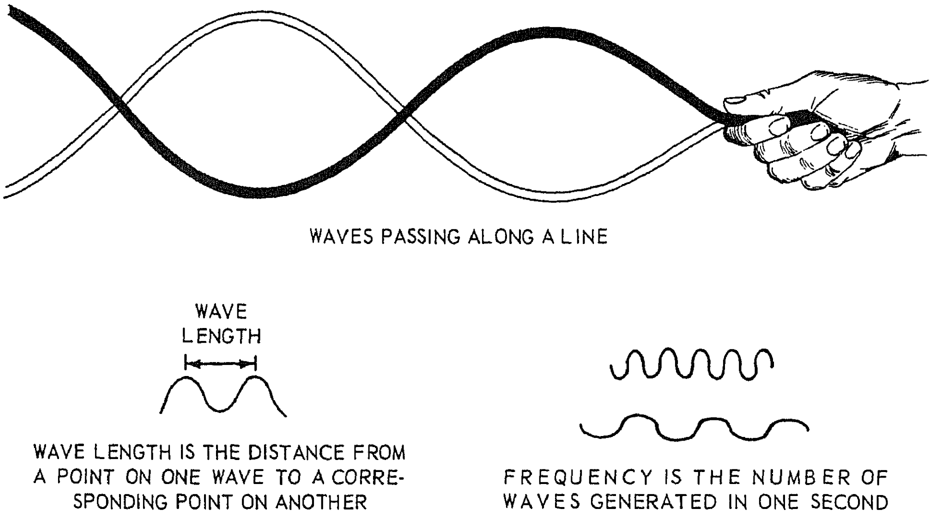
Figure 5-1.—Part of the electromagnetic spectrum. Light waves and radio waves are the same kind of energy; however, they vary in frequency and wavelength.


WAVES PASSING ALONG A LINE
WAVE LENGTH
WAVE LENGTH IS THE DISTANCE FROM A POINT ON ONE WAVE TO A CORRESPONDING POINT ON ANOTHER
FREQUENCY IS THE NUMBER OF WAVES GENERATED IN ONE SECOND

57.584

Figure 5-2.—If you tie a piece of string to an object and then shake the string, a wave will travel from your hand down the length of the string. You might compare this wave with that produced by a luminous light source, such as a light bulb, which acts as an oscillator, creating waves of light. The wave motion of the string, however, does not represent the true motion of light, because light waves move in all directions.

microwaves, and light waves are all a part of the electromagnetic spectrum. Although all of these waves of magnetic energy are similar, they vary in frequency and wavelength.

Wavelength and frequency go hand in hand. (See fig. 5-2.) Wavelength is the distance from a point on one wave to a corresponding point on the next wave. Waves vary in length according to the type of wave, from less than a millionth of an inch to several thousand miles. Frequency is the number of waves generated in one second. As waves become shorter, they increase in rapidity or frequency; and as they lengthen, their frequency is reduced. In other words, short waves have a high frequency and long waves have a low frequency. The frequency of visible light waves, for example, is millions of times greater than that of radio waves.

Light waves are part of the electromagnetic spectrum, whereas sound waves are not. Sound waves differ from light waves in that they consist of a physical compression of the air (an elastic medium), while light waves are an electromagnetic vibration. However, the two have certain properties in common. For example, if you drop a pebble into a pool of still water, the pebble will cause the water to create a series of expanding waves. Figure 5-3 shows what happens when sound and light travel. Sound and light spread from their source in circular waves, moving in all directions.

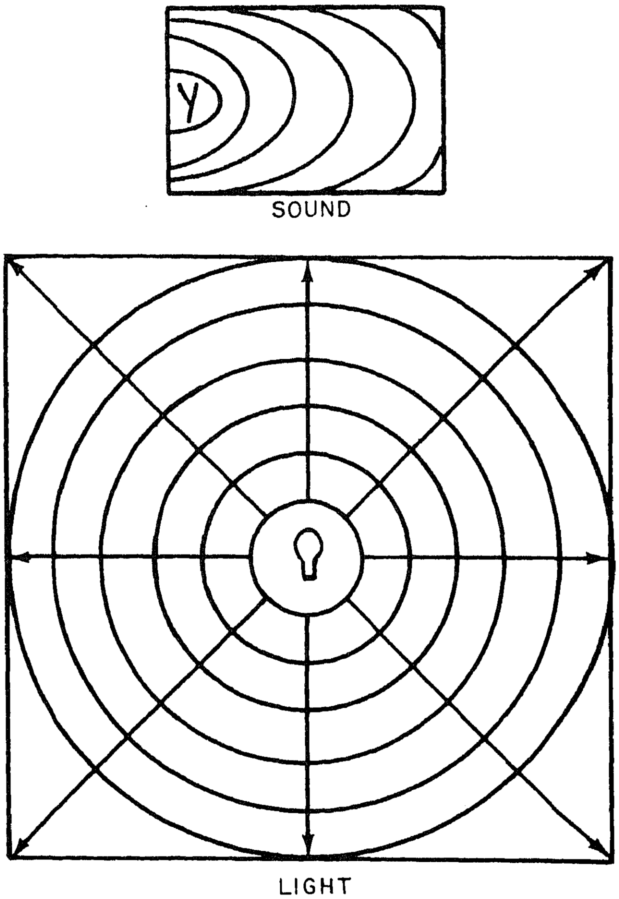


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Figure 5-3.—Illustration of the radiation (motion) of sound and light.

Light waves act in much the same manner. They are always stronger near their source because the rays are closer together at this point. As the waves move away from their source, the rays fan out or spread, thus causing the waves to become weaker.

REFLECTION

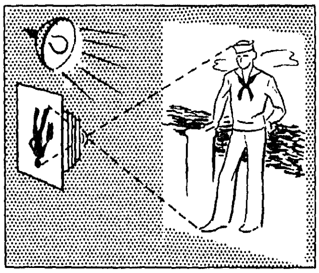
Light rays that are not absorbed or transmitted by an object are bounced back (reflected). If light rays strike a smooth surface, such as a mirror, at a 90° angle, they will be reflected at a 90° angle; if light rays strike the surface at a 45° angle, they will be reflected at a 45° angle, and so on. Because the rays are reflected in only one direction, this is known as regular reflection; and the reflected light is called specular light. But when a beam of light strikes a rough surface, the rays may be reflected in several different directions. This is known as diffuse reflection, and the reflected light is called diffused light.

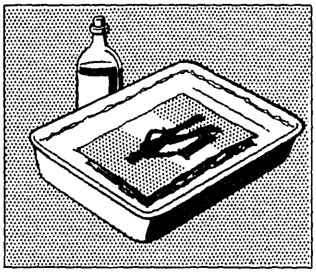
Most surfaces reflect both types of light. However, smooth surfaces normally reflect specular light, and rough surfaces normally reflect diffused light. Since diffused light is more common than specular light, it is considered more valuable in photography. Figure 5-4 shows how light rays reflected from an object pass into a camera to form an image.

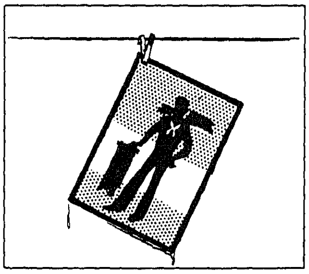
HOW WE SEE COLOR

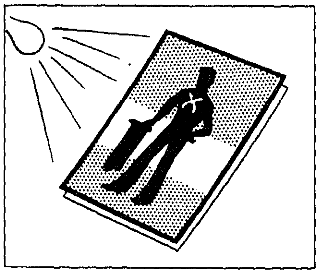
The eye detects visible light waves somewhat as the ear detects tones. The ear cannot detect extremely long sound waves, but as the waves become shorter, they increase in frequency and become audible—first as a low rumble or bass sound and finally, as the frequency increases, as a treble sound or a screech. If the sound waves become too short, the frequency will become so high that the ear cannot detect them.

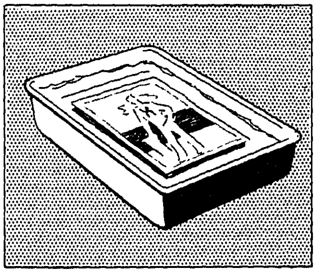
The longest waves (lowest frequencies) that the eye can see produce the sentation of red. There are

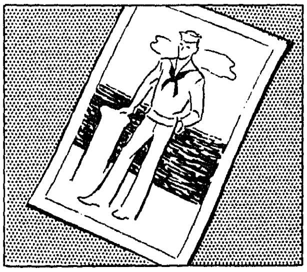

LIGHT IS REFLECTED FROM THE SUBJECT INTO THE CAMERA AGAINST THE FILM


THE PORTION OF THE SENSITIZED EMULSION AFFECTED BY LIGHT TURNS DARK WHEN DEVELOPED IN THE PROPER CHEMICALS.


THE DEVELOPED FILM IS CALLED A NEGATIVE BECAUSE THE LIGHT IS REGISTERED ON IT IN REVERSE —BLACKS ARE WHITE AND VICE VERSA.


A POSITIVE PRINT CAN BE MADE BY EXPOSING SENSITIZED PAPER TO LIGHT THROUGH THE FILM AND DEVELOPING AS BEFORE.


THE PORTIONS OF THE PAPER EXPOSED TO LIGHT BY THE TRANSPARENT PARTS OF THE NEGATIVE WILL TURN GREY OR BLACK WHILE THE REMAINDER OF THE PAPER REMAINS WHITE


A PICTURE APPROXIMATING THE ORIGINAL SCENE IS CALLED A "PRINT."

longer waves, called infrared, but they cannot be seen. The shortest waves that you can see produce the sensation of violet. Ultraviolet waves are too short and their frequency too high to be detected by the human eye.

When you listen to music, you hear sounds from not one but a combination of sound waves of various frequencies. When you look at objects, you see light from a combination of wavelengths and frequencies. If all of the optical wavelengths are combined, your eye receives the sensation of white. But a colored light will result if one of the wavelengths predominates the other wavelengths.

Sound waves can pass through air or they can be transmitted through an elastic substance, such as water. Other objects, such as drapes or the tiles used for soundproofing, absorb sound. If a sound wave strikes an object it cannot penetrate, it is bounced back (reflected). An echo is a common example of reflected sound.

Light waves also can be transmitted, absorbed, or reflected. If an object reflects all the wavelengths equally, it will look white; but if it absorbs some of the wavelengths, it will appear colored. A red object, for example, appears red because it reflects red light waves and absorbs the light waves of all the other colors. However, if you look at a red object under a mercury vapor light, it will appear black because the mercury vapor light has no red in its composition for the red object to reflect. In other words, a colored object always reflects the light waves of its own color, and it appears black (colorless) if the colored object absorbs all the colors or if the light striking it does not include the wavelengths of its particular color.

You can see through clear glass and water because they are transparent, and light can pass through them easily. Although light also passes through frosted glass and waxed paper, you cannot see through them clearly because they are translucent. Substances such as wood and concrete are said to be opaque because light cannot pass through them. When light passes through a substance that is denser than air, such as glass, the speed of the light is reduced. If the light rays strike the substance at a 90° angle, they will pass through without bending. But if they strike at any other angle, the change in speed will cause the light rays to bend. This is known as refraction. You will learn more about refraction later in this chapter.

BASIC PRINCIPLE OF PHOTOGRAPHY

Perhaps you have noticed how certain colors fade or bleach when they are exposed to sunlight. The radiant energy of the light sets up a chemical action whenever it strikes the dyes, causing them to change color. Photographers use this actinic action of light to produce images on film coated with light-sensitive salts.

To produce a photographic image, you must have a light source, a means of focusing the reflected light, a light-sensitive film or plate, and a means of making the image visible and permanent. Daylight may be used for taking pictures outside, but artificial light is generally required for indoor photography.

PHOTOGRAPHIC EQUIPMENT

Cameras are used for focusing reflected light. A camera is simply a box from which all light is excluded except that passing through a small opening at the front. Cameras are equipped with various devices for controlling the light rays as they pass through the opening. When you press the shutter release button on an ordinary camera, a mechanical blade or curtain, called the shutter, opens and closes automatically. When the shutter opens, the light reflected from the subject passes into the camera through a piece of optical glass called the lens. The lens focuses or projects the light rays onto the wall at the back of the camera much the same as a motion picture projector projects an image onto a screen in a darkened theater.

PHOTOGRAPHIC OPERATIONAL STEPS

You can capture a light image by attaching a piece of film to the back of the camera. Film, as you may already know, is simply a sheet of transparent acetate coated with a layer of gelatin in which millions of tiny particles of silver salts are suspended. In the first step, film is exposed in the camera. Silver particles that are struck by the light are ionized or broken up. Shadows and dark areas reflect little light; therefore little change occurs in the film emulsion in areas where the subject is dark. But there is a good deal of change in areas where the emulsion is struck by strong light reflections. These changes are not visible to the eye as a rule.

In the next step, when the film is placed in a chemical developing solution, the exposed particles of silver salts change to black, metallic silver. In areas where the film was struck by strong light reflections, the silver deposit will be very dense or black; in areas where the light reflections were weaker, the silver deposit will be thinner and have a gray appearance on the film. Areas of the film that correspond to the dark or shadow areas of the original subject may have received no light reflection at all; therefore, the silver salts in these areas are not exposed and will not turn dark in the developer unless development is continued too long. However, these unexposed salts will still be affected if they are exposed to light.

In the next step, the film is placed in the stop bath. The stop bath is to stop the development action of the developer and to reduce the amount of contamination of the fixer.

So, during the next step, the film must be fixed in another chemical solution called hypo. This solution dissolves the unexposed salts and leaves clear, transparent areas on the film. The film is then washed and dried. The developed film is now called a negative because the light has registered on it in reverse. That is, it is dark where the original subject was light, and transparent where the original subject was dark. As a rule, for the lithographer this is the final photographic step.

However, there are other steps you can take to make a positive print. For example you can expose a piece of sensitized paper to the light through the negative. The negative will act as a stencil, holding back part of the light and passing part of it on to the light-sensitive coating on the paper. After the exposure, the print is processed in much the same manner as the negative. This time you will have a duplicate of the original subject with dark and light areas corresponding to those of the original. (See fig. 5-4.) You can also use the negative for making a positive copy on film or for making an offset press plate. You will learn more about negatives and offset press plates later in this training manual.

THE PROCESS CAMERA

The camera used in lithographic photography is called a process camera. Although larger than the type of camera used to take snapshots, it is similar in principle. Since the process camera is built for copying, it is equipped with a copyboard and has other features not associated with the average camera. There are two types of process cameras: horizontal and vertical. The horizontal process camera is the type used often in the Navy and in commercial shops. However, Navy print shops aboard ships are equipped with vertical process cameras because they use less floor space. Both horizontal and vertical cameras are similar in their components and operations.

HORIZONTAL PROCESS CAMERA

The horizontal process camera is also known as a darkroom camera because the back of the camera, as a rule, is built into the darkroom wall. (See fig. 5-5.) (The term *darkroom* refers to the room where the film is developed.) Because the back of the camera extends into the darkroom, the camera operator can load the film, focus the camera, make the exposure, and develop the film without leaving the darkroom. Of course, since the front is housed in a separate room, sometimes called the camera room, the camera operator or a helper must go outside the darkroom to place copy in the copyboard before the exposure is made.

Another type of horizontal process camera that is housed entirely in one room is called a gallery camera. Since there aren't any gallery cameras in use in the Navy and the operating instructions are similar to the horizontal and vertical models, the gallery camera will not be discussed.

All process cameras have three parallel planes or surfaces (see fig. 5-6):

1. The copy plane (copyboard to which the copy is attached).
2. The lens plane (lensboard or front of the camera into which the lens is fitted).
3. The focal plane (back of the camera which consists of a film-holding device and a ground (frosted) glass viewing surface). The image projected through the lens is focused onto this plane or surface.

These three planes are generally mounted on a spring-suspended bed, which is attached to the floor or deck; however, on large cameras, they may be suspended from overhead tracks. Springs, rubber, and similar materials are used to absorb shock and to keep the units from jarring or moving while the film is being exposed.

Handwheels or cranks are usually provided at the back of the camera to enable the camera

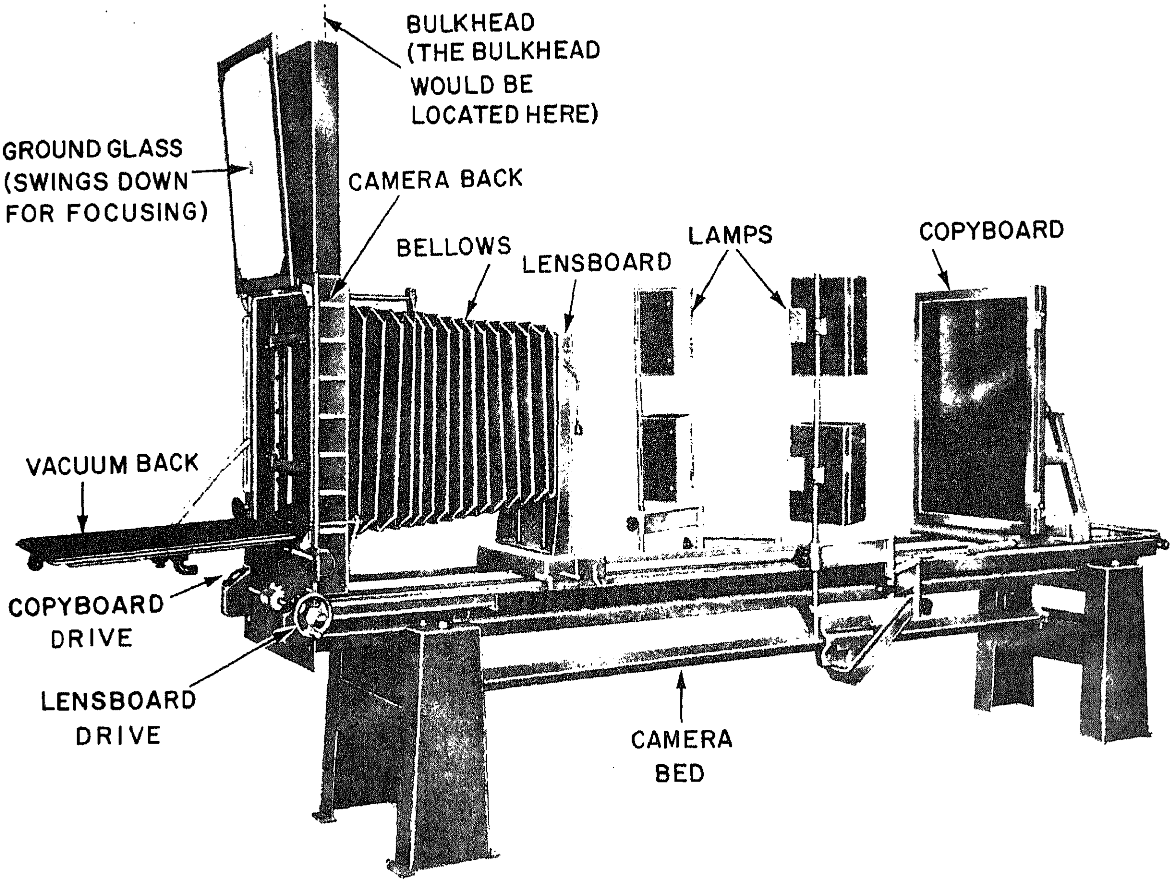


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Figure 5-5.—Horizontal process camera.

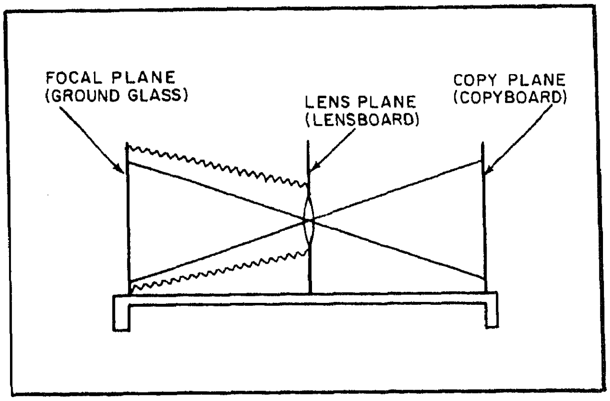

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Figure 5-6.—The process camera consists basically of three parallel planes.

operator to move two of these planes forward or backward (up or down in the case of a vertical camera) along the tracks while focusing. This movement sets (focuses) the camera so that the light rays will come together to produce a sharp image of the proper size on the ground glass. Generally, the back of the camera is stationary, and the lensboard and copyboard can be moved for focusing. But if the position of the copyboard is fixed, the lensboard and the back of the camera are movable. On some cameras, all three planes are movable.

The positions of the copyboard, lensboard, and back of the camera affect the size as well as the sharpness of the image. When the camera is set so that the ground glass and the copyboard are both the same distance from the lens, it is said to be set for same-size shot, because the image on the ground glass is the same size as the image on the original copy. If the lensboard is moved closer to the back of the camera, the image is reduced; and if the lensboard is moved farther away, the image is enlarged.

Most process cameras are equipped with scales that show the camera operator where to set the copyboard and lensboard for the amount of enlargement or reduction required. If these scales are not available, or if the lens used does not match the calibrations on the scales, the camera operator has to focus the camera by watching the image on the ground glass as the copyboard and lensboard are moved. In this case, the camera operator must measure the image with a ruler to see that it is the proper size and examine it with a magnifying glass to see that the fine lines are sharply focused before the exposure is made. This is known as visual focusing.

The exposure is not made through the ground glass. Before making the exposure, the camera operator should swing the ground glass out of the way and then move the film-holding device into place. On darkroom cameras, the film-holding device usually consists of a grooved metal door, called a vacuum back, that holds the film perfectly flat by suction. On cameras not equipped with a vacuum back, the film holder consists of a door that is covered with a sticky substance called "stayflat."

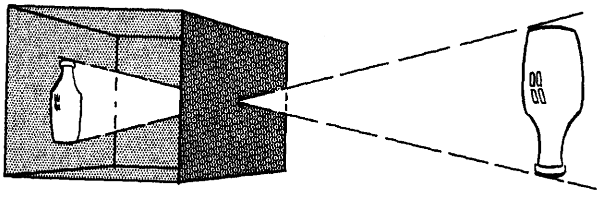
Lenses

The lens is the camera's "eye." To understand how the lens works, study the pinhole camera shown in figure 5-7. This is the simplest form of camera. In fact, it is so simple that you can make one yourself by attaching a piece of film to one end of a cardboard box, sealing the box so that all light is excluded, and then punching a pinhole in the opposite end from the film. Although an extremely long exposure is required, you can use the pinhole camera to take pictures of objects where no motion is involved.

IMAGE FORMATION.—After you have studied the diagram shown in figure 5-7, you will see how the pinhole camera forms an image. Notice how the light rays pass through the pinhole and onto the back of the box. Notice, too, that the image formed there is upside down (reversed). This is because the light rays travel in straight lines and cross each other at the pinpoint opening.

In figure 5-8, each point on the copy reflects light rays in all directions, but because the pinhole opening of the camera is so small, only one ray from each point on the copy can pass through the pinhole to reach the film. Think of the copy as consisting of millions of these tiny points, each reflecting a light ray to a corresponding point on the film. Now you can better understand how these points combine to form an image, or likeness, of the original copy on film.

Unfortunately the pinhole camera has little practical value because it takes an extremely long time to expose the film. You can cut down exposure time by making a larger pinhole. The larger opening will let in more light, but will also cause the image to be blurred, because the large opening allows more than one ray from each point



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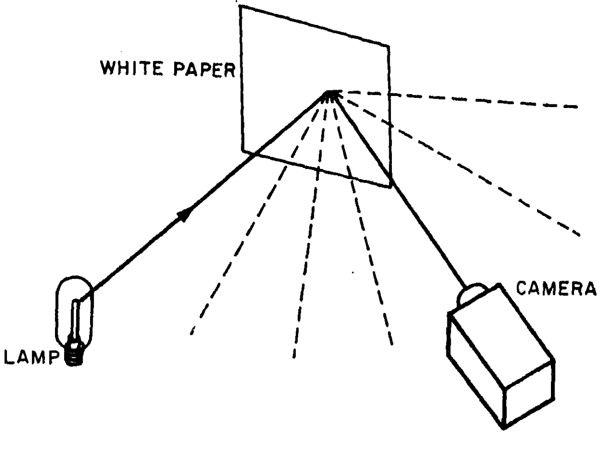

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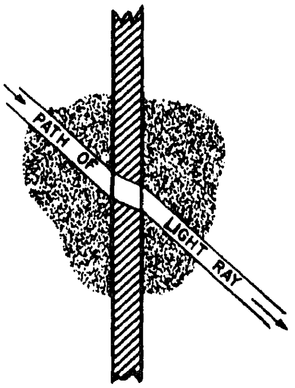
Figure 5-8.—How light rays are reflected from a point on

on the copy to enter the camera. This causes the rays to overlap on the film.

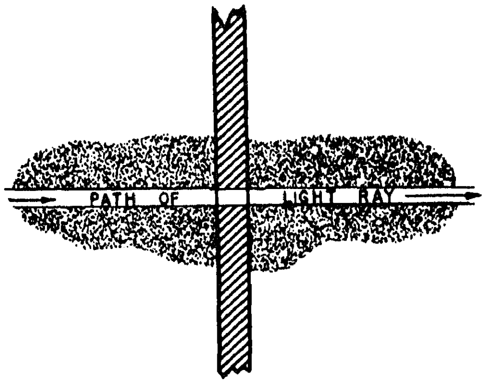
When you use a larger opening, you must have some means of controlling the light rays—and that is where the lens comes in. The lens is a piece of optical glass, scientifically ground to catch the light rays reflected from each point on the copy and to bend them so they will converge (come together) again at a point inside the camera.

When the light rays strike the lens, the resistance of the glass changes the speed of the light and causes the oblique rays to bend, as shown in figure 5-9.

The lens is capable of receiving numerous light rays from a single point and bending them so that they will all converge to form a similar point behind the lens (fig. 5-10). The diagram in figure 5-11 shows how this principle is applied to form an image on the film.



LIGHT RAYS STRIKING THE LENS OBLIQUELY (AT AN ANGLE) ARE BENT BY THE LENS.



RAYS STRIKING THE LENS PERPENDICULARLY WILL NOT BE BENT ALTHOUGH THEY WILL BE SLOWED DOWN CONSIDERABLY.

57.52

Figure 5-9.—Refraction of light. It is upon this principle that the design of photographic lenses is based. The extent of refraction depends on the slant at which the light strikes the lens, on the composition and color of the light, and on the difference in optical density between the lens and the air.

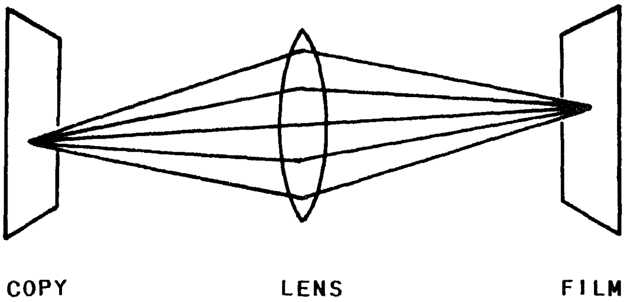


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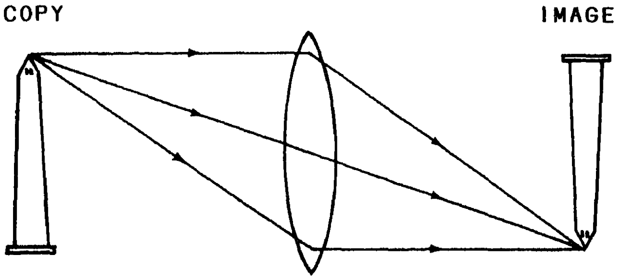
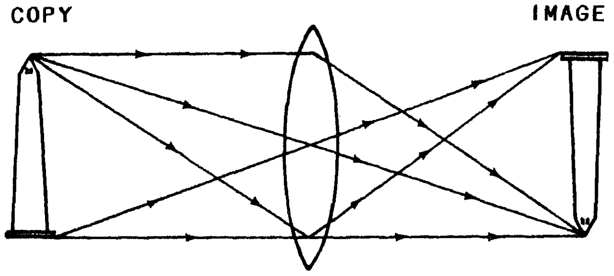
Figure 5-10.—Light rays and how they travel.



HOW LIGHT RAYS FROM ONE POINT ON THE COPY CONVERGE TO FORM A SIMILAR POINT ON THE FILM.



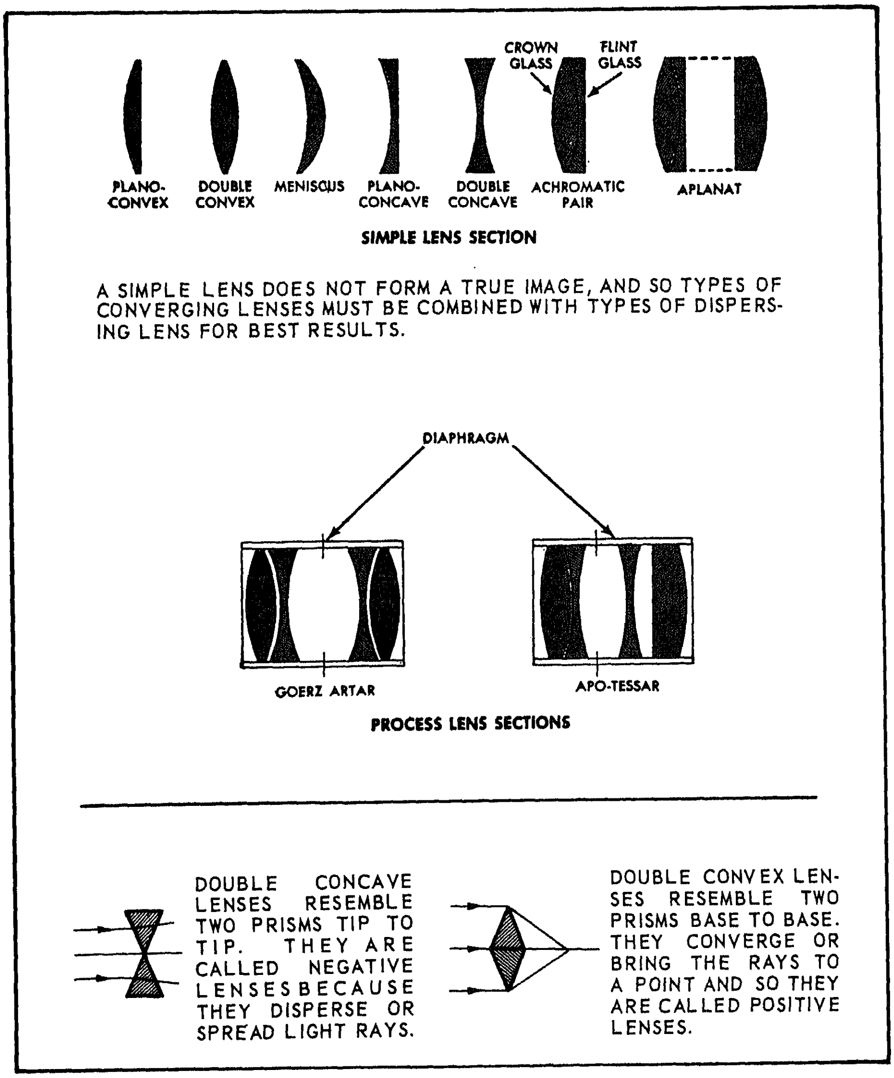
HOW LIGHT RAYS FROM TWO POINTS ON THE COPY CONVERGE TO FORM TWO SIMILAR POINTS ON THE FILM. THE OVERALL IMAGE IS FORMED ON THE FILM BY SETS OF LIGHT RAYS, SUCH AS THESE, REFLECTED FROM THE MILLIONS OF TINY POINTS THAT COMBINE TO MAKE UP THE ORIGINAL COPY.

57.54

Figure 5-11.—Image formation by a lens.

verge behind it to form a single point on the film. You can also see how rays emanating from a point at the base of the subject pass through the lens and converge to form another point on the film. The diagram is simplified for the sake of clarity. Actually, the lens can capture any number of rays emanating from each point on the copy and bring them together again to form similar points inside the camera. As in the case of the pinhole camera, the overall image, or likeness, is formed on the film by sets of rays reflected from the millions of tiny points that combine to make up the original copy.

the one shown in figure 5-11, cannot form a sharp image. Therefore, some of the rays coming from a particular point on the copy do not meet at the same point on the film, and this causes a slight fuzziness. Lens manufacturers correct this fault by combining lenses that spread the light (negative or divergent lenses) with lenses that cause the light rays to converge or come to a point (positive or convergent lenses). (See fig. 5-12.) Two or more lenses (called elements) are joined together in a metal tube known as the lens barrel. The entire assembly



A SIMPLE LENS DOES NOT FORM A TRUE IMAGE, AND SO TYPES OF CONVERGING LENSES MUST BE COMBINED WITH TYPES OF DISPERSING LENS FOR BEST RESULTS.

DOUBLE CONCAVE LENSES RESEMBLE TWO PRISMS TIP TO TIP. THEY ARE CALLED NEGATIVE LENSES BECAUSE THEY DISPERSE OR SPREAD LIGHT RAYS.

DOUBLE CONVEX LENSES RESEMBLE TWO PRISMS BASE TO BASE. THEY CONVERGE OR BRING THE RAYS TO A POINT AND SO THEY ARE CALLED POSITIVE LENSES.

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Figure 5-12.—Types of lenses.

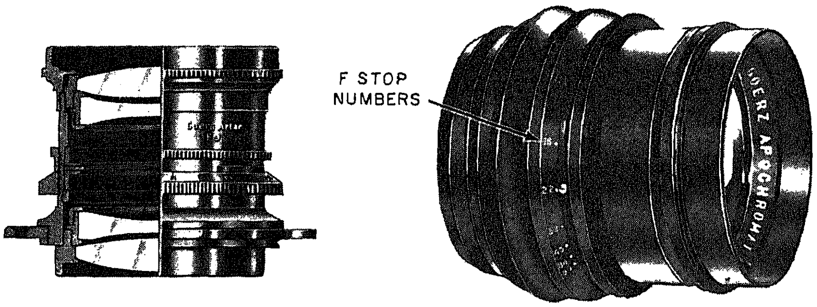

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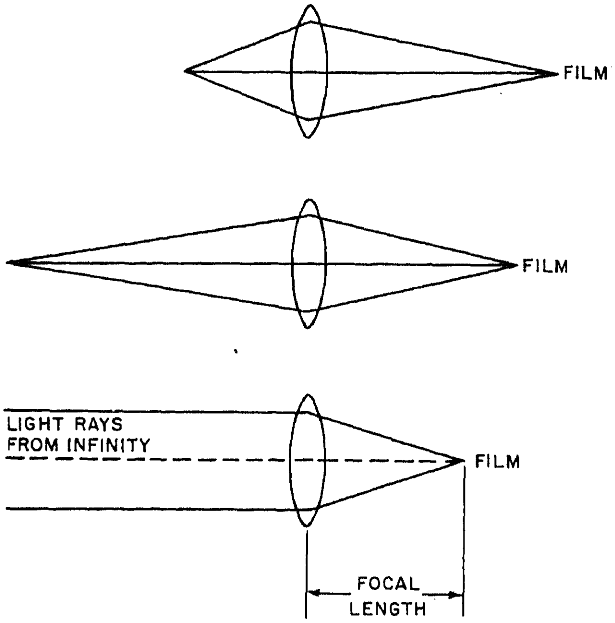
Figure 5-13.—Process camera lenses.

is then referred to as the lens. (See fig. 5-13.)

FOCUSING.—You have just seen how the light rays from the copy pass through the lens to form an image at a point inside the camera. Look at figure 5-14. Notice that light rays from an object near the camera come into focus at a point a considerable distance behind the lens. When the object is farther away from the camera, the light rays come into focus closer to the lens. If the object is moved far enough away from the camera, the lens is said to be focused at an infinite distance or focused at infinity. Thus the image will form at the closest possible point behind the lens.



57.57

Figure 5-14.—Focusing the lens.

When you focus a lens, only those objects that are a specific distance from the lens will be in absolute focus. Objects farther away or closer to the camera will be slightly fuzzy, although the distortion may be so slight that the eye will not notice it. The ability of the lens to produce (at one setting) a reasonably sharp image of several objects at various distances from the camera is known as depth of focus (also called depth of field). Depth of focus is not as important in process camera work as it is in other types of photography, because you are shooting flat copy, all portions of which are the same distance from the film. But it does allow you a slight tolerance when you are setting up the camera, particularly when you are focusing for reductions.

Of course, the process camera operator is concerned with size as well as sharpness of the image. You have already seen that when the copyboard and ground glass are focused at the same distance from the lens, the image formed is the same size as the original copy.

If the image needs to be enlarged, the camera operator should move the lensboard away from the ground glass and then move the copyboard into focus.

If the image needs to be reduced, the camera operator should move the lensboard closer to the ground glass and then adjust the copyboard. (See fig. 5-15.)

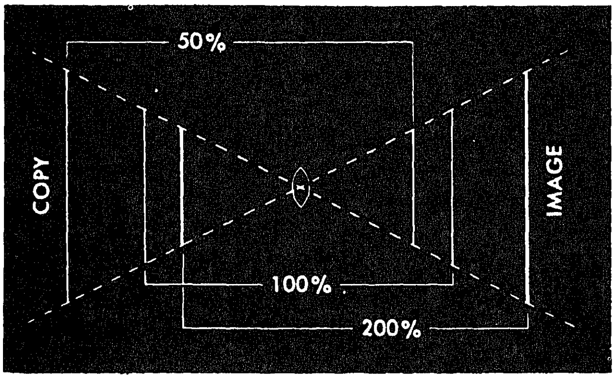


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Figure 5-15.—As the lens is moved away from the film, the image area grows larger and the area of copy that the lens can cover is reduced. As the lens is moved toward the film, the image area is reduced and the lens can cover a larger copy area.

FOCAL LENGTH.—Lenses are usually classified by focal length, speed, and degree of correction for distortion and other aberrations. (See fig. 5-16.) Focal length is simply the distance from the optical center of the lens to the point behind the lens where the sharpest image is produced when the camera is focused on an object at infinity. The focal length of a lens is expressed in inches to identify the lens, for example, a 10-inch lens or a 12-inch lens and so forth.

There are three factors that control focal length: the curvature of the lens surfaces, the kinds of glass used for the lens, and the separation of the elements of the lens.

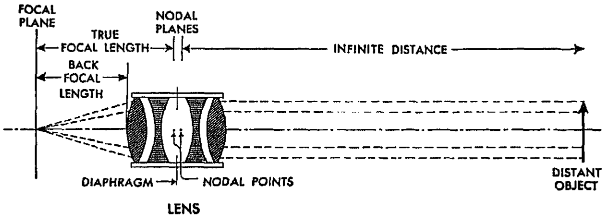

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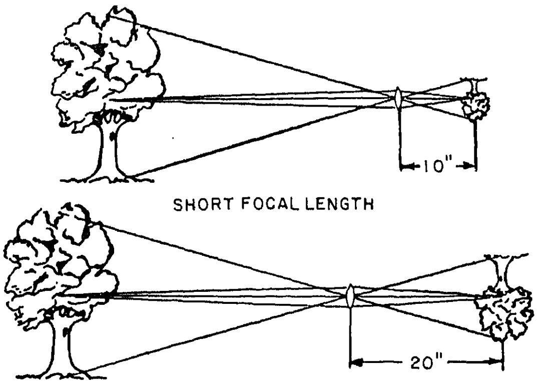
Figure 5-16.—Process lens characteristics. You can use the rated length of your lens for calculating purposes. For approximate distances, the middle of the lens barrel can be taken as a point for all measurements, although in exact calibrations, two theoretical points within the

There are many different methods of determining focal length, but we are not concerned with them here because focal lengths are determined by the manufacturers and are stamped on the lens barrel.

In process camera work, the size of the image depends on the distance between the copy and the lens, the distance between the lens and the film, and the focal length of the lens.

As the lens is moved away from the film at the back of the camera, the image area on the film grows larger and the area of copy that the lens can cover decreases. The opposite occurs when the lens is moved toward the film. Lenses with long focal lengths have greater covering power and produce larger images than those with short focal lengths. For example, if a 12-inch lens will produce an image 4 inches wide when the copyboard is a certain distance from the lens, then a 24-inch lens will produce an 8-inch-wide image at the same copy-to-lens distance. (See fig. 5-17.) In other words, lenses with long focal lengths include less copy area, but any object in that area will appear larger on the film than it would if photographed with a lens having a shorter focal length.

LAW OF INVERSE SQUARES.—Lenses with long focal lengths can produce larger images than those with short focal lengths because they are capable of projecting a sharp image farther



57.60

Figure 5-17.—The size of the image in relation to the

into the camera. (See fig. 5-18.) When the lens is moved away from the film, the light is spread over a greater area and the image is enlarged.

But, spreading the light weakens its intensity—the more the light is spread, the weaker it becomes. Look at figure 5-19. If it takes 15 seconds to make a proper exposure when the distance between the lens and film is 1 foot, it will take 60 seconds (four times as long) to get the same exposure when the distance is increased to 2 feet. Because the distance between the film and lens is doubled, the light is spread over four times its former area and is so weakened that it will take four times as long to get the proper exposure.

Tripling the distance will enlarge the image nine times, and an exposure nine times longer than the original will be required. This decrease in strength as the light travels through the air can be expressed by a mathematical rule known as the law of inverse squares, which states "the strength of light varies inversely as the square of the distance from the light source."

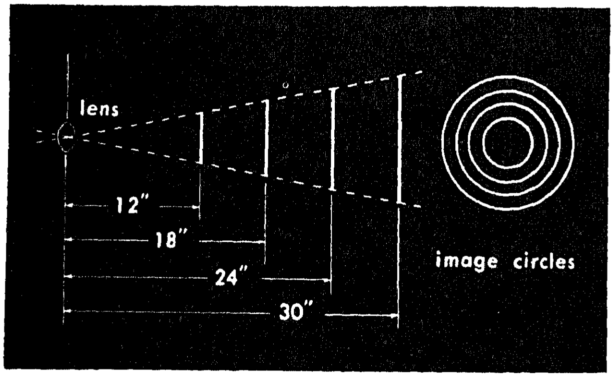


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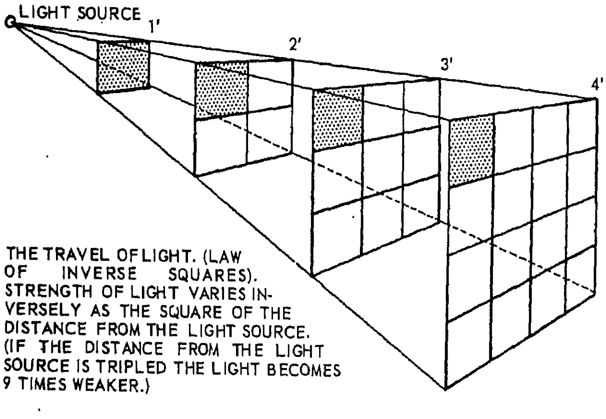
Figure 5-18.—The lens focal lengths and their part in the law of inverse squares.


LIGHT SOURCE
1'
2'
3'
4'
THE TRAVEL OF LIGHT. (LAW OF INVERSE SQUARES).
STRENGTH OF LIGHT VARIES INVERSELY AS THE SQUARE OF THE DISTANCE FROM THE LIGHT SOURCE.
(IF THE DISTANCE FROM THE LIGHT SOURCE IS TRIPLED THE LIGHT BECOMES 9 TIMES WEAKER.)

57.62

Figure 5-19.—Illumination principles.

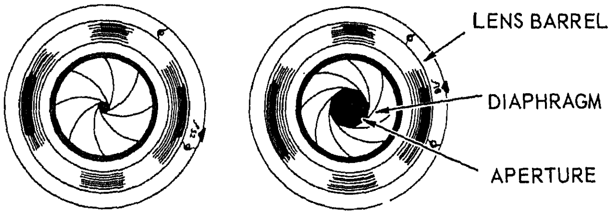
The camera operator can compensate for this decrease in light strength in either of two ways:

1. by increasing exposure time
2. by using a larger lens opening to let more light enter the camera in the same amount of time

LENS DIAPHRAGM.—Each lens barrel contains a device known as the lens (iris) diaphragm. The diaphragm consists of a series of thin metal or composition blades arranged to form the lens aperture, a circular opening in the center of the lens barrel. By turning a collar on the outside of the lens barrel, the camera operator can adjust these blades to increase or decrease the size of the aperture and thus regulate the amount of light entering the camera. (See fig. 5-20.)

F/NUMBERS.—You have seen in figure 5-17 that when the distance between the lens and the copy remains constant, a lens with a long focal length will project the image farther into the camera and create a larger image than will a lens with a short focal length. Of course, the farther the image is projected, the weaker the light becomes; so the exposure must be lengthened or the aperture adjusted accordingly to produce the proper exposure on the film.

To maintain the required relation between the amount of light entering the camera and the distance light must travel once it gets inside, camera operators have adopted a scale of values called f/numbers or f/stops. These f/numbers or f/stops show the relation of the lens opening to the focal length of the camera.



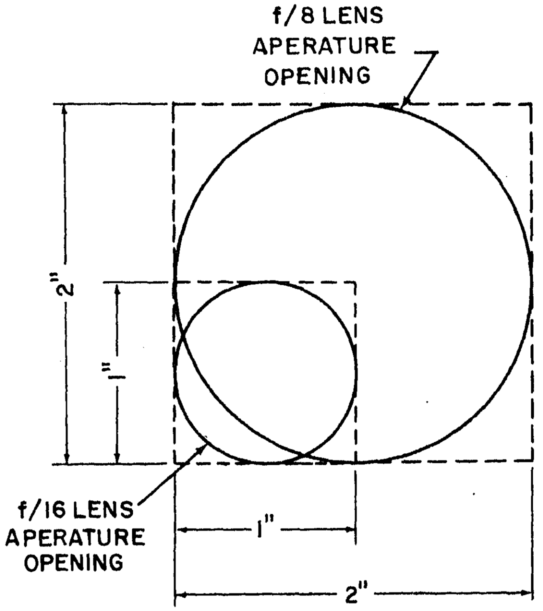
40.163

Figure 5-20.—The aperture setting is made by adjusting the lens diaphragm.

The f/numbers are marked on the lens collar and are used to set the aperture. Each f/number represents a fractional part of the focal length of the lens. When the camera operator sets the collar at f/8, the diaphragm will automatically form an opening in the lens barrel that is one-eighth as wide as the focal length of the lens. If the focal length of the lens is 16 inches, the diameter of the lens opening will be 2 inches at the f/8 setting. (See fig. 5-21.) Similarly, setting the aperture at f/16 will mean one-sixteenth of 16 or a 1-inch opening, and so on.

Occasionally, the camera operator needs a lens opening smaller than the highest lens aperture setting can provide. To get the smaller opening, place a thin metal blade that has a drilled hole the size of the required lens opening into a slot provided in the lens barrel. This metal blade is called a Waterhouse stop. The slot is sometimes called the filter slot because it is also used for the insertion of filters.

LENS SPEED.—The smallest f/number represents the largest diaphragm opening. Beginning with f/1, each succeeding major f/number is determined by multiplying the f/number by 1.4 (the square root of 2).



57.63

Figure 5-21.—Comparison of lens aperture openings of a 16-inch lens.

Listed below are the major f/numbers or f/stops:

f/1, f/1.4, f/2 *, f/2.8, f/4, f/5.6, f/8, f/11, f/16, f/22, f/32, f/45, f/64, f/90.

*In some cases the numbers are rounded off to the nearest whole number.

An f/number falling in between these major stops is known as an intermediate stop. All cameras do not have the full range of f/stops. The f/numbers on the high-speed cameras used by sports photographers, for example, may range from f/1 through f/22, whereas the numbers on a process camera may begin at f/8 and run through f/90. The speed of a lens is determined by the *smallest* f/number, which gives you the *largest aperture* of the diaphragm. A lens with an f/1 opening is faster than one with a maximum opening of f/8 because the f/1 opening is relatively larger and lets in more light, thereby reducing exposure time.

For many years it was believed that greater detail and sharpness were obtained from process camera lenses when they were stopped (closed) down to the *lower* aperture settings. But tests have proved that the sharpest image is realized when the lens is stopped down one or two stops from the *highest* lens aperture setting. For example, if the camera you are operating has an f/11 lens, the lens aperture setting on a same-size exposure should be f/16 or f/22 for best results.

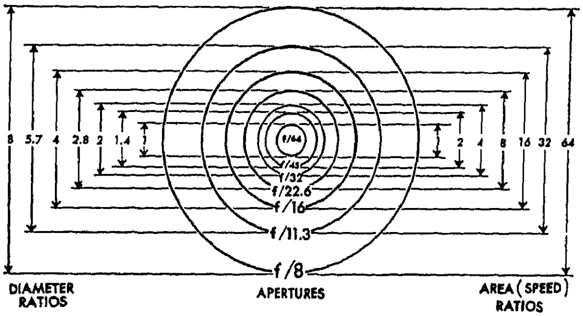
The length of an exposure depends on the lens aperture setting. Using the next larger or next smaller major lens opening either halves or doubles your exposure time. For example, a 10-second exposure at f/11 will require 5 seconds at f/8 or 20 seconds at f/16. Look at figure 5-21. You will see that the f/16 lens aperture opening is only one-fourth as large as the f/8 opening. Therefore, an f/16 lens aperture opening lets in only one-fourth as much light, and the exposure time must be increased four times to produce the same effect on the film.

The following example shows the relative exposure times required for the major lens openings.

			f/numbers			
8	11	16	22	32	45	64
			Relative exposure time in seconds			
1	2	4	8	16	32	64

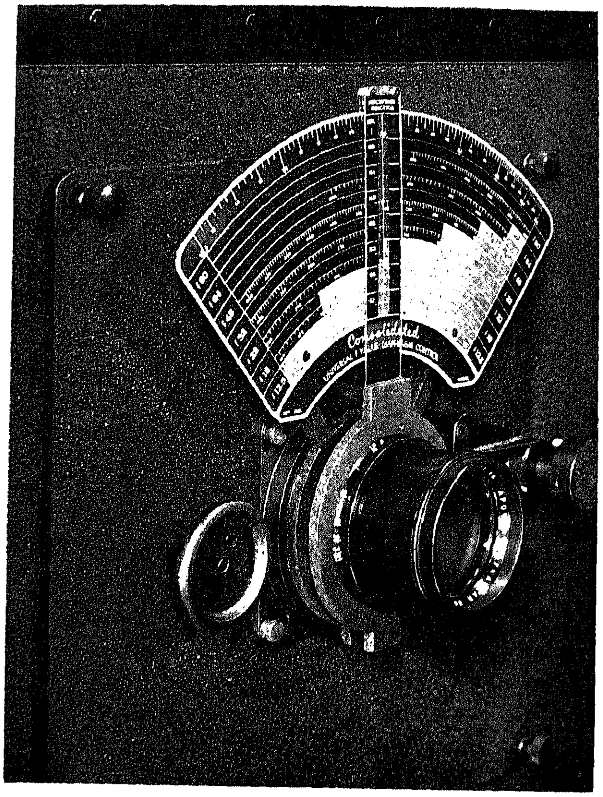
Figure 5-22 illustrates the comparative areas of lens stops.

LENS DIAPHRAGM CONTROLS.—The basic exposure time and aperture setting for same-size (1:1) work vary with the speed of the film and the particular camera set-up you are using. A series of test exposures will determine the basic exposure time and aperture setting for the camera you are operating.



57.64

Figure 5-22.—Comparative areas of lens stops.



57.65X

Figure 5-23.—Diaphragm control system.

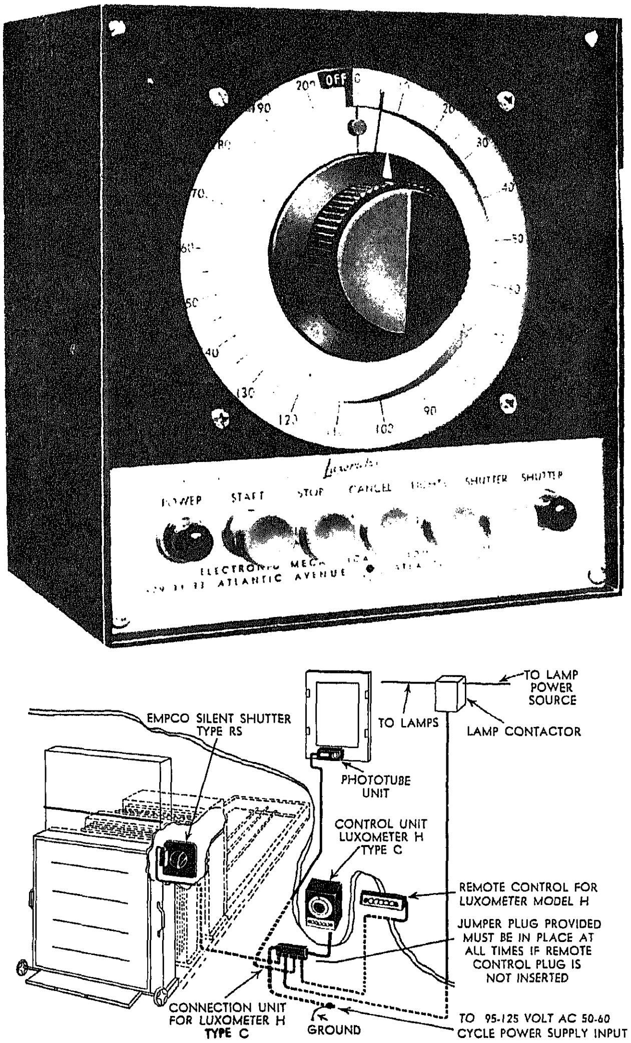
Earlier in this chapter you learned that the intensity of light received by the film varies as the distance between the lens and the film is changed. A change in film-to-lens distance occurs when the camera extension is changed for an enlargement or a reduction of the original copy. The purpose of the lens diaphragm is to open or close the lens aperture, thereby regulating the amount of light the film receives. The exposure time remains the same regardless of the camera extension.

There are several types of diaphragm control systems, but the one shown in figure 5-23 is typical of those found on many process cameras. It consists of a pointer, which is attached to the lens collar, and a metal plate, which is attached to the lens barrel. The plate has a series of scales—one for each major f/stop—and each scale is graduated to show percentages of enlargement or reduction. The camera operator determines the percentage of enlargement or reduction with a scaling plate, like the one shown in figure 5-23, simply by moving the pointer to the proper place along the selected f/stop scale. Since the pointer is attached to the lens collar, the aperture is set automatically.

SHUTTERS.—Process cameras are equipped with a shutter, which opens to admit light through the lens or closes to stop the passage of light. The shutter is located behind the lens and is electrically operated. It is connected to a timer, which is set for a predetermined length of time. When the start button on the timer is pushed, the shutter and the camera lamps are activated simultaneously. When the time of the exposure has expired, the camera lamps turn off and the shutter closes.

Some cameras are equipped with a light-integrating device, consisting of a photoelectric cell that is attached to the copyboard and connected to a control unit by wires. The photoelectric cell measures the amount of light falling on the copy and transmits electrical impulses to the control unit. The electrical impulses are registered on a timing device that automatically closes the shutter and turns off the lights to end the exposure after the required amount of light has been registered. (See fig. 5-24.)

Some of the older-model process cameras did not have shutters, and the camera operator controlled the length of the exposure with a lightproof cap (called the lens cap), which fit over the end of the lens barrel. The camera operator


OFF
POWER
START
STOP
CANCEL
SHUTTER
SHUTTER
ELECTRONIC MECHANICAL
ATLANTIC AVENUE
TO LAMP POWER SOURCE
TO LAMPS
LAMP CONTACTOR
EMPCO SILENT SHUTTER TYPE RS
PHOTOTUBE UNIT
CONTROL UNIT LUXOMETER H TYPE C
REMOTE CONTROL FOR LUXOMETER MODEL H
JUMPER PLUG PROVIDED MUST BE IN PLACE AT ALL TIMES IF REMOTE CONTROL PLUG IS NOT INSERTED
CONNECTION UNIT FOR LUXOMETER H TYPE C
GROUND
TO 95-125 VOLT AC 50-60 CYCLE POWER SUPPLY INPUT

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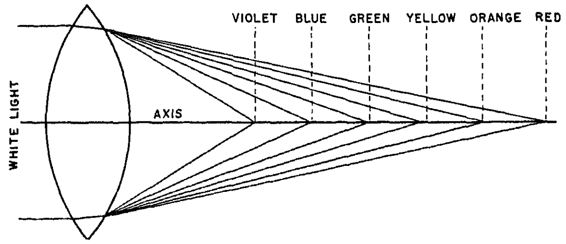
57.69X

Figure 5-24.—Light-integrating device.

removed this cap to make the exposure and, after the required time, replaced it to bring the exposure to an end. Today's process cameras are still equipped with a lens cap to protect the lens surface when the camera is not in use.

LENS ABERRATIONS.—A single lens cannot form a sharp image because it cannot bend all light rays uniformly. The light rays passing through the outer edges of the lens are bent more than those passing near the center, for example, and they will not meet at the same point.

Rays of certain colors are also bent more than others. (See fig. 5-25.) If you look at printed matter through a magnifying glass, you may find colored outlines around the letters. These outlines are there because the lens does not focus all colors on the same plane. White light is composed of a series of colored waves—some longer than others. As these colored waves pass through the lens, the waves are bent. Shorter wavelengths are bent more than longer wavelengths. Since these rays do not come together at a single point, they tend to overlap and create a blurred or outlined image.



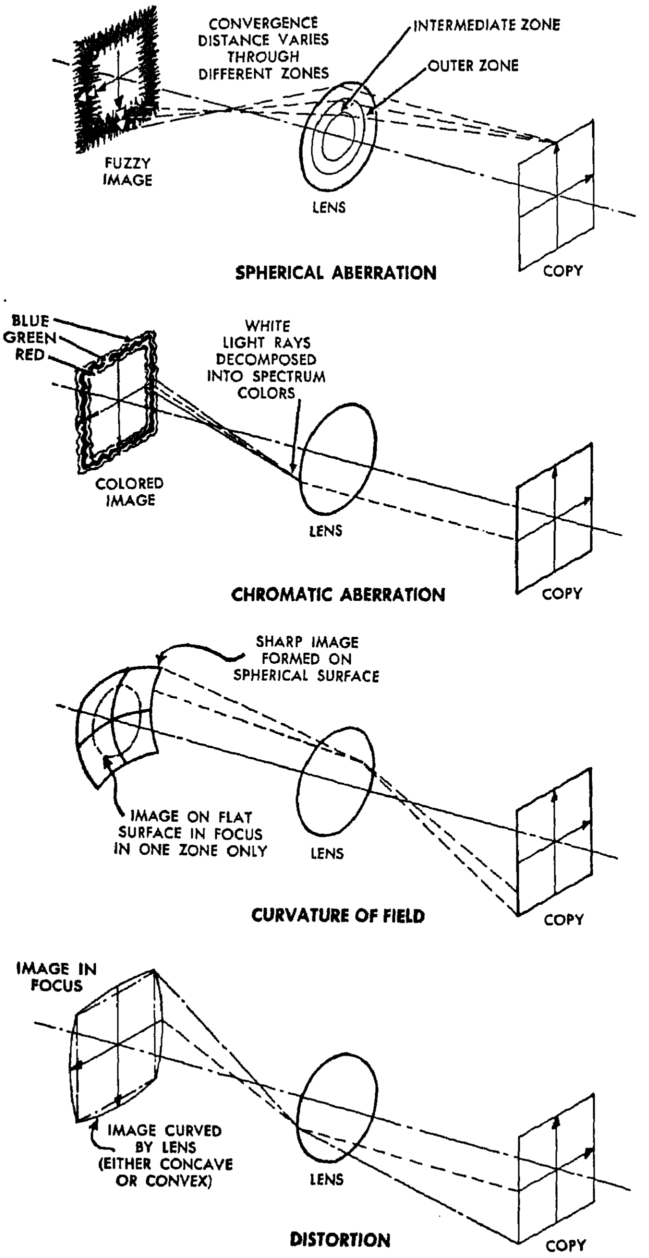
57.67

Figure 5-25.—Convergence of colored rays from white light.

These lens defects are known as aberrations. There are several types of aberrations common to all lenses:

Chromatic aberration is the inability of the lens to focus all colors on the same plane. (See fig. 5-25.) You can minimize chromatic aberration (see fig. 5-26) by using a smaller lens aperture opening, or the manufacturer can correct it by using a combination of lenses made of different types of glass. Crown and flint glass are generally used for this purpose. And the lenses are ground so that they bend the light rays in opposite directions. One lens spreads the light rays, while the other lens brings the rays together to a point. This combination of lenses causes the longer wavelengths to be refracted more sharply and the shorter wavelengths to have less refraction so that most chromatic aberration is cancelled out before it reaches the film. Lenses corrected to bring two of the primary colors together on the same plane are known as achromatic lenses. Lenses corrected to focus all the primary colors are called apochromatic lenses.

Spherical aberration occurs when the light rays passing through the outer edges of the lens focus on a different plane from those passing through the center. This causes the edge of the image to be out of focus when the center is sharp, and vice versa. (See fig. 5-26.) The manufacturer


CONVERGENCE DISTANCE VARIES THROUGH DIFFERENT ZONES
INTERMEDIATE ZONE
OUTER ZONE
FUZZY IMAGE
LENS
COPY
SPHERICAL ABERRATION
BLUE
GREEN
RED
WHITE LIGHT RAYS DECOMPOSED INTO SPECTRUM COLORS
COLORED IMAGE
LENS
COPY
CHROMATIC ABERRATION
SHARP IMAGE FORMED ON SPHERICAL SURFACE
IMAGE ON FLAT SURFACE IN FOCUS IN ONE ZONE ONLY
LENS
COPY
CURVATURE OF FIELD
IMAGE IN FOCUS
IMAGE CURVED BY LENS (EITHER CONCAVE OR CONVEX)
LENS
COPY
DISTORTION

57.66

Figure 5-26.—Lens aberrations.

corrects this condition by combining positive and negative lenses, by calculating suitable curvatures for each lens element, and by varying the thickness and separation of the elements. Stopping down the lens aperture opening will also reduce spherical aberration.

Coma is characterized by fuzziness along the margins of the image due to the light rays' forming ovals (pointing to the center of the image) instead of points. It is caused by the unequal refracting power of the different areas of the lens. The image of a point of light is formed by numerous light rays that are refracted through a relatively wide portion of the lens. For the light rays to form a sharply defined point of light inside the camera, the rays that pass through the outer edges of the lens must come to focus at exactly the same point in the focal plane as those passing through the center of the lens. Coma happens when rays of light emanating from a point on the copy pass through the outer portions of the lens and do not converge to form a single point. Instead, the light rays form several overlapping points, and this creates an egg- or pear-shaped blur along the margin of the image.

Coma can be corrected by the use of a combination of negative and positive lenses, and it can be minimized by stopping down the lens aperture opening.

Astigmatism is the inability of the lens to project a sharply focused image of both horizontal and vertical lines on the same plane. When this aberration is present, the lens seemingly has two focal lengths—one for the horizontal lines and another for the vertical lines, especially when these lines are in the margins of the image. For example, if you were photographing a crossmark (+), you would find that the vertical line would be out of focus when the horizontal line was focused, and vice versa. If you adjust the focus between the horizontal and vertical focuses, the image of the crossmark will be slightly blurred, but the lens will form the best image at this distance. You can reduce the blur somewhat by stopping the aperture down and using only the center portion of the lens.

Astigmatism is corrected through the use of a combination of lenses of different kinds of optical glass. When lenses are corrected for astigmatism and chromatic aberration, other aberrations are corrected at the same time. However, eliminating astigmatism while retaining a flat field is difficult, so a negligible amount of aberration exists in even the best of lenses.

Curvature of field causes the center of the image to be out of focus when the margins are in focus, and vice versa. It results from a curved lens that cannot form a perfect image at all points on a flat surface. The usual compromise with such lenses is to focus midway between the two extremes and to reduce the size of the aperature opening. The manufacturer corrects this aberration by combining positive and negative lenses of various radii of curvature. When the lens has been corrected in this manner during manufacture, it is said to have a flat field. Modern lenses have a noticeable degree of this aberration, however, when used with large apertures.

Distortion causes the straight lines of the image to appear curved, particularly along the outer margins. Because some areas of the lens magnify more than others, the lines are bent in one direction when the aperture is placed in front of a simple lens. And the lines are bent in the opposite direction when the aperture is placed behind the lens. It is possible to correct this form of aberration by placing the aperture in the center of the lens barrel between the lens elements.

FLARE.—Flares or hot spots are nebulous patches of light caused by internal reflections in the lens. Occasionally they originate from spots within the lens mount where the blacking has worn off. You can have these spots repainted to eliminate future trouble.

Flare can also be caused by the lens itself. (See fig. 5-27.) When light strikes the first element in the lens, part of the light goes through and part of it is reflected. Similarly, when light strikes the next element, part of the light goes through and part of it is again reflected. This time the reflected light bounces from the second element back to the first, and from there the light is reflected back to the second element. Eventually, some of the light will get through to form an image.

Some optical flare is present in all lenses, but you can reduce the flare by using a lens hood, a dull black lensboard, or a dust-free lens, or by changing the angle of lighting. Lenses often are coated with a chemical solution to reduce optical flare.

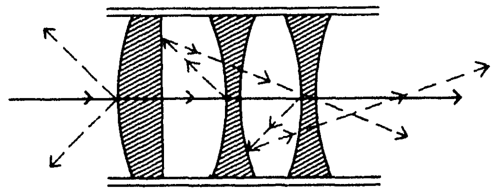


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Figure 5-27.—How flares or hot spots are formed in the lens barrel. Center arrow indicates path of light forming image. Broken line represents reflected light.

CARE OF THE LENS.—The lens is an extremely delicate piece of equipment and must be handled with great care. Therefore, here are some do's and don'ts of lens care, handling, and storage.

DO

- brush dust particles from the lens surface with a camel's hair brush.
- clean the lens with a soft tissue moistened with a small amount of lens cleaner.
- close the filter slot and place the lens cap over the lens barrel when the camera is not in use.

DON'T

- use alcohol, polish, or other solvents on the lens.
- take the lens apart for cleaning; that is the manufacturer's job.
- store lenses in places where they are apt to be exposed to extreme temperature changes.
- expose lenses to light or air.
- touch the glass portion of a lens with your fingers, as fingerprints will cause loss of definition on the negative.

Filters

Although filters are not a part of the camera, their use is so closely connected with the lens that they will be discussed at this point.

Filters are used to alter the color and intensity of the light for color correction and (in process color work) to separate the primary colors of the copy.

If you look at a colored picture through a blue filter, you will see that the filter practically neutralizes the blues while making the yellows look darker so that it will be easy to photograph the yellows. Similarly a red filter will cancel out the reds in the picture, but it will make the greens look black.

Yellow filters are frequently used in photographing colored copy. Yellow absorbs blues and some of the violets and gives the negative a more balanced appearance. Yellow filters are also used in copying old papers or photographs that are yellowed with age, because the yellow filter causes the yellow background to photograph as white.

Colored filters always absorb part of the light reflected from the copy. Therefore, a longer exposure is necessary when colored filters are used. The number of times the exposure must be increased when a filter is used is known as the filter factor. The exposure time varies not only with the color of filter being used but with the type of film and the characteristics of the light as well. Normally, the film manufacturer supplies this information on the film container or on an information sheet in the film container.

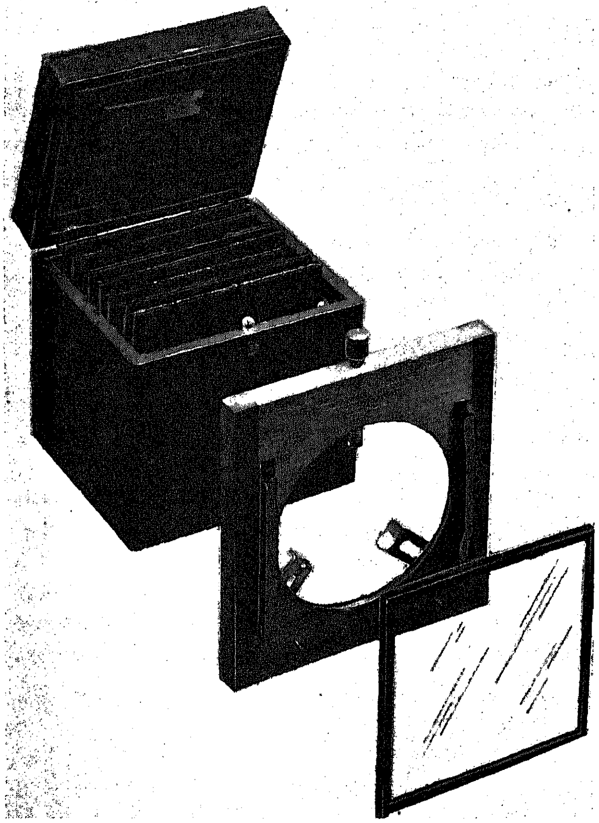

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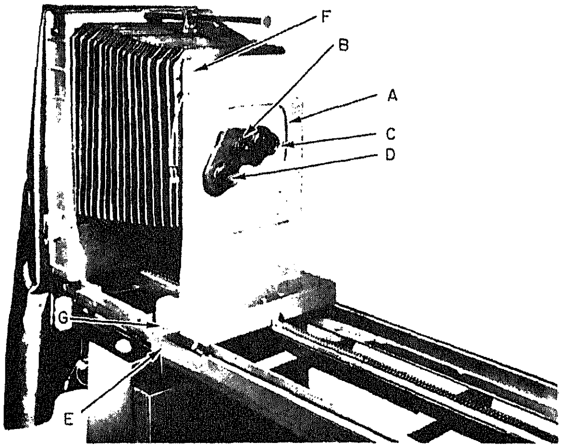
Figure 5-28.—Process camera filters and holder.

Filters can also cause the image to be out of focus. Therefore, final critical focusing for exact size and sharpness should be made on the ground glass by sight *after* the filter is in position. Process camera filters usually consist of a sheet of colored gelatin cemented between two layers of optical glass. These filters can be inserted into a wooden frame mount, which slips over the lens barrel and is locked in place with three setscrews. (See fig. 5-28.) Other types of filters do not require a separate mounting attachment and can be inserted directly into the filter slot in the lens barrel if the lens is so designed.

Lensboard

Figure 5-29 shows the lensboard (A) on a camera. The length of the camera bed and the distance the copyboard and lensboard can be moved limit the amount of enlargement or reduction that can be obtained with a process camera. The camera shown in the illustration has a 90-inch bed and is equipped with two apochromatic lenses on the lens turret (B), one having a focal length of 16 inches and the other, 12 inches. The 16-inch



A. Lensboard
B. Lens turret
C. 16-inch lens
D. 12-inch lens
E. Storage compartment for lens
F. Shutter switch
G. Lensboard lock

57.71X

Figure 5-29.—Lensboard on a darkroom camera.

lens (C) is used for the general run of work, but the 12-inch lens (D) is used for enlargements or reductions greater than can be obtained with the lens having the longer focal length.

Study figure 5-30 to see why the 12-inch lens is needed. The table shows the distance from the lens to the film, the distance from the lens to the copy, and the total distance between the copy and the film. The bed of the camera is 90 inches long, and the total distance between the lens and the film cannot exceed this distance. Notice in the illustration the image may be enlarged or reduced five times without exceeding the 90-inch distance when you are using the 12-inch lens, but you cannot enlarge or reduce the image more than three times without exceeding this distance when you are using a 16-inch lens.

You can loosen the knob that secures the turret and swing either of the lenses into operating position when it is needed.

To secure your lenses when they are not in use, loosen the knob and remove the turret completely. Be careful that the spring behind the lens does not slip out when this is done. You can lock the turret in the storage compartment ([E] in fig. 5-29). When you remove the lenses in this manner, always cover the hole in the lensboard with tape to prevent dust from entering the camera. Each of the lenses in the turret is equipped with a slot for inserting filters (colored glass, film or gelatin) or Waterhouse stops (metal blade having a round or oddly shaped hole), and each has a lens diaphragm that provides openings ranging from f/11 to f/90.

The shutter is electrically operated and is built in behind the lens. If you operate it through the timing device, you simply set the dial on the timer for the desired time. Then push the start button. At the end of the time selected, the shutter will close automatically and the lights will go off.

If you are focusing the camera on the ground glass, you will not want to use the timing device in connection with the shutter. In this case, you can switch the lights on separately and then flip a switch on the control box at the back of the camera to open the shutter. The shutter will then stay open and the lights will stay on until you flip the switches again.

In addition to the control box in the darkroom, the shutter can also be operated with the shutter switch ([F] in fig. 5-29) on the side of the lensboard.

You can move the lensboard to the proper position along the scale on the camera bed during focusing by turning a handwheel at the back of the camera. The handwheel moves a chain or gear to which the lensboard is attached. Once the image is focused, you should lock the lensboard in place with the lensboard lock lever ([G] in fig. 5-29) so that no movement will occur during the exposure.

The lensboard is similar on other makes of cameras. However, you will find that some

Focal length of lens

Ratio of enlargement or reduction	12-inch			16-inch		
	Lens to film	Lens to copy	Total copy to film	Lens to film	Lens to copy	Total Copy to film
100%	24''	24''	48''	32''	32''	64''
50%	18''	36''	54''	24''	48''	72''
200%	36''	18''	54''	48''	24''	72''
33 1/3%	16''	48''	64''	21.3''	64''	85.3''
300%	48''	16''	64''	64''	21.3''	85.3''
25%	15''	60''	75''	20''	80''	100''
400%	60''	15''	75''	80''	20''	100''
20%	14.4''	72''	86.4''	19.2''	96''	115.2''
500%	72''	14.4''	86.4''	96''	19.2''	115.2''

57.563

Figure 5-30.—Comparison of the various copyboard and lensboard distances required for lenses having 12-inch and 16-inch

cameras are not equipped with a lens turret. In this case, the lens is simply screwed into an opening in the lensboard, and a spare lens may be kept locked in a compartment at the base of the lensboard or elsewhere in the shop.

Some cameras are also equipped with operating controls located at the back of the camera. These controls enable you to shift the mounted lens horizontally or vertically to center the image on the ground glass during focusing.

Bellows

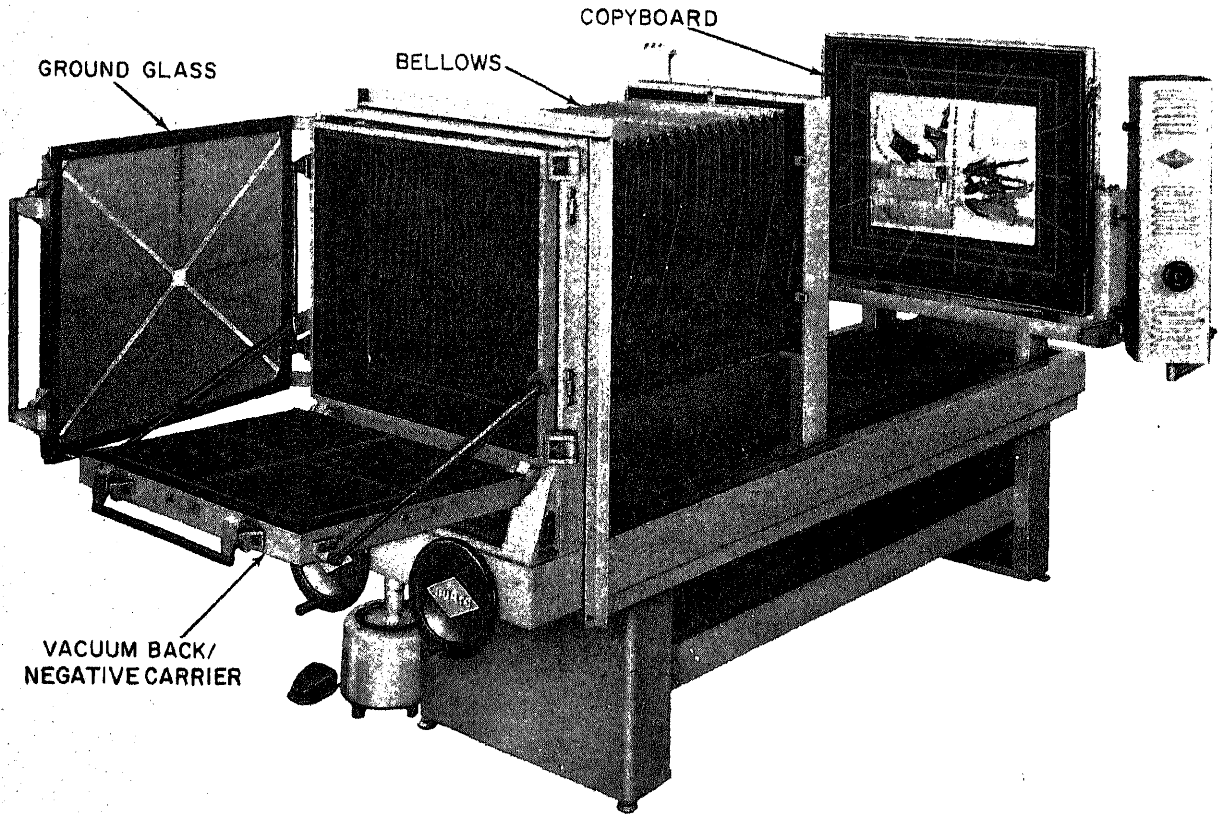
Just behind the lensboard is an accordian-pleated material that forms a light tunnel from the lens to the back of the camera. It is called the bellows. (See fig. 5-31.) The bellows consists of specially treated black material attached to a series of wooden or metal frames. It is lighttight or lightproof and is flexible enough to allow for the movement of the lensboard for proper focusing. The distance between the film and the lens is often referred to as the camera extension or bellows extension.

You should inspect the bellows occasionally to make sure that it is completely lighttight, since light leaks may spoil your camera work.

Ground Glass

The back of the darkroom camera is housed entirely within the darkroom. It is made up of several parts, including the ground glass, the negative carrier (vacuum back), and sets of camera controls.

The ground glass is usually mounted in a hinged metal frame with its frosted surface in the same optical plane as the film. Sometimes the manufacturer leaves clear reference lines in the frosted surface of the glass to aid the camera operator in positioning and focusing the image. (See fig. 5-31.) In critical focusing, the camera operator measures the image with a ruler to see that the image is the proper size. The camera operator also examines the image with a magnifying glass (linen tester) to see if the fine lines are focused sharply. Once the image is in focus, the camera operator swings the ground glass out of the way (or removes it from the camera) and



57.74X

Figure 5-31.—The darkroom camera ready for loading of the film on the vacuum back.

positions the negative carrier in the same optical plane in which the ground glass was positioned.

Vacuum Back/Negative Carrier

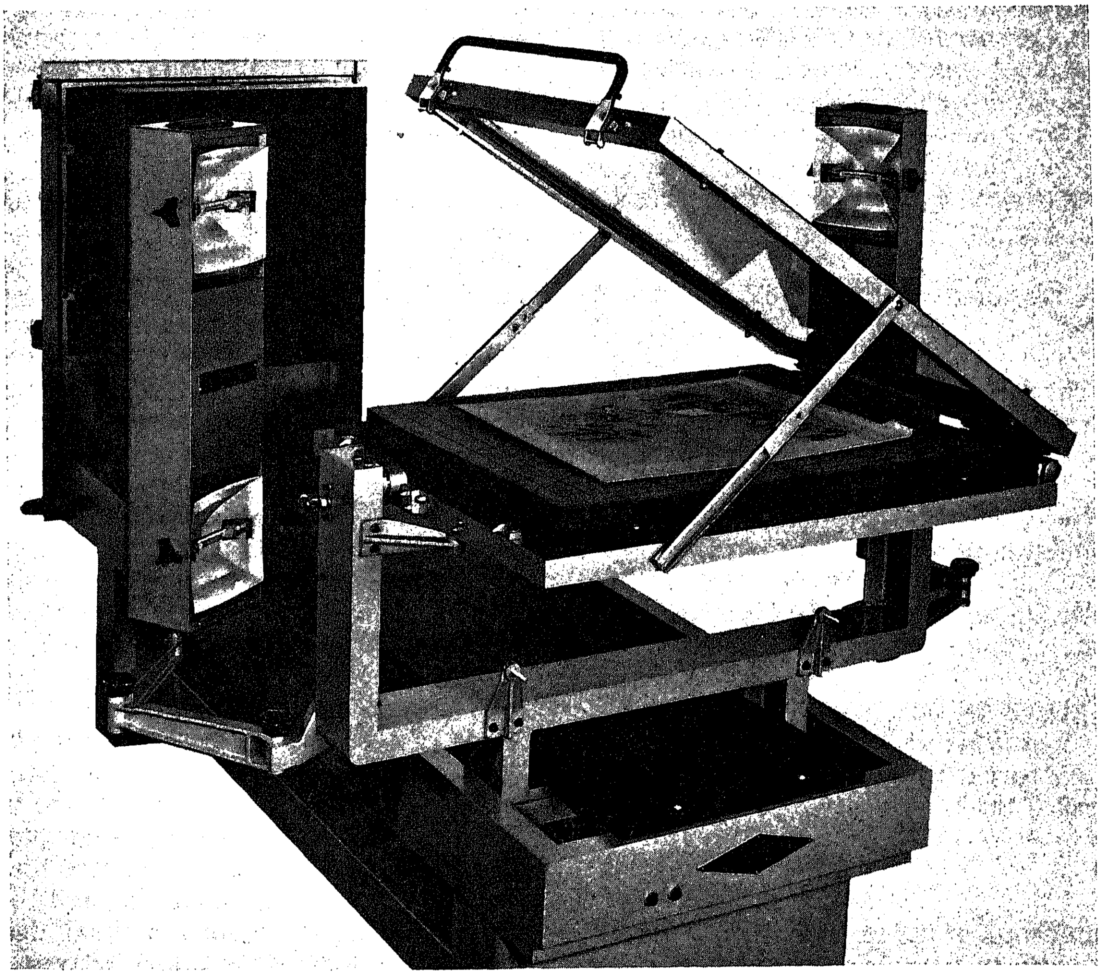
The vacuum back/negative carrier shown in figure 5-31 is a hinged, flat metal door with a series of rectangular channels corresponding to standard film sizes. Each channel is connected to a suction line, and the suction is controlled by a valve. The vacuum should be applied only to the channels for the film size you are using. Some types of vacuum backs have a knob to vary the coverage of the suction; others have slide levers on the reverse side that are positioned for the film size.

The vacuum back/negative carrier shown in figure 5-31 will accept many different sizes of film. If you are using an odd size piece of film that doesn't fit the vacuum back, you can place small pieces of tape along the edges of the film to hold it flat. Before closing the vacuum back, check to ensure that the film is in complete contact with the vacuum back. You can do this by looking at the film at an angle to catch any reflections from the darkroom safelights. If there are reflections, you should adjust the suction or use tape to make good contact.

The vacuum pump and its motor require little attention other than proper lubrication.

Copyboard

Copyboards vary from one type of camera to another, just as lensboards do. In some cases, the copyboard consists simply of a bed for the copy and a hinged, glass cover. You should tilt the copyboard to a horizontal position and open the cover when you are inserting the copy to be photographed. (See fig. 5-32.) After the copy has



57.73X

Figure 5-32.—The copyboard in the loading position.

been positioned on the bed, you should close the glass cover, lock it in place, and swing the frame back to its vertical position for focusing. When the glass cover is closed, the bed squeezes the copy against the glass cover (by means of spring pressure) to flatten the copy and hold it in place.

Reference lines are generally marked on the surface of the copyboard under the glass to aid you in centering and aligning the copy. If the camera does not have these lines, you may draw your own reference marks on any white material and fasten it to the copyboard bed.

Some types of process cameras have a vacuum pump that provides suction to hold the copy flat in the copyboard. After you place the copy in the copyboard, close and lock the cover, turn the vacuum pump on, then tilt the copyboard to the vertical position.

After the exposure has been completed, return the copyboard to the horizontal position. Turn off the vacuum pump and open the glass cover. Remove the copy, close and lock the cover, and then tilt and lock the copyboard in the vertical position.

Remember how you should always keep the glass of the copyboard clean?

Here are some important facts you should remember.

- The copyboard can be moved along the scale on the camera bed by means of a handwheel at the back of the camera.

- Never move the copyboard when it is in a horizontal position.

- Do not leave the copyboard in a horizontal position.

- Always be sure that the glass cover is securely locked before you attempt to move the copyboard back to its vertical position. The glass can break if the cover swings open.

Lamps

Illumination of the copyboard on a process camera comes from artificial lights or lamps. The lamps are normally attached to the copyboard and travel as part of the copyboard, or they may be free-standing units. The free-standing lamps are placed according to the position of the copyboard. You will perhaps see this type of lamp in use at shore activities and large commercial shops.

The principal requirement of the light source is that it must produce an extremely bright white light, which is suitable for both color and black-and-white reproduction. This type of light is said to have a high actinic value; that is, it readily affects the silver salts in the film emulsion.

The most useful light sources for graphics art reproduction are the quartz iodine lamp, the pulsed xenon lamp, and the mercury vapor lamp.

Camera lamps are placed into one of two categories: the incandescent lamps or the electric discharge (arc) lamps.

The pulsed xenon lamp, for example, is of the arc variety. It consists of a tube of quartz glass, which is filled with xenon gas, and has an electrode at each end. The xenon lamp is said to be pulsed because it flashes 120 times a second, although the light output seems constant to the eye. The tubes may be fashioned as coils, semicircles, or angles to fit particular requirements. For example, many of the new lamp holders designed for exposing photo-offset plates are fitted with coiled pulsed xenon tubes.

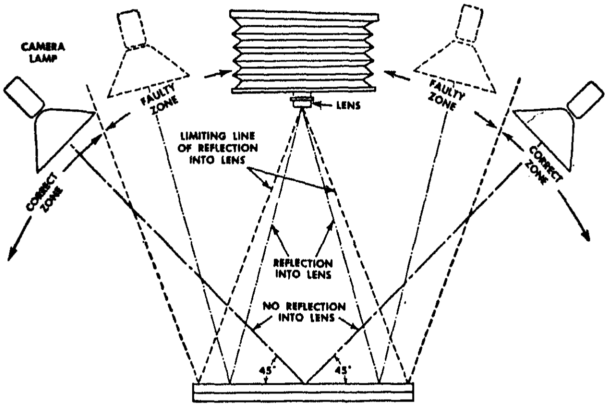
The iodine quartz lamp is of the incandescent variety, but it bears little resemblance to the conventional light bulb. The lamp consists of a short tube of quartz glass, housing a coiled filament that runs the length of the tube. In ordinary incandescent lamps, tungsten evaporates from the filament and settles on the glass to gradually darken the bulb. In the case of the iodine quartz lamp, however, iodine vapor combines chemically with the tungsten and causes it to redeposit on the filament. This prevents the tube from tarnishing with age. Although the iodine quartz tube is very small (about the size of a ball-point pen), it puts out such an intense light that it is particularly suited for use with photolithographic equipment designed to conserve space, such as vertical cameras.

The short-arc lamp differs from the pulsed xenon lamp because it has a shorter gap between the electrodes in the tube and the tube has a bulge in the center which corresponds to the location of this gap. Although mercury lamps produce a very intense light and are often used for black-and-white work, they cannot be used for color work because they do not contain all the colors of the spectrum. For example, mercury lamps have no red radiation; therefore, all reds in the copy photograph as black. Xenon lamps produce a light that closely resembles natural daylight.

POSITIONING THE CAMERA LAMPS.—As stated before, the lamps are usually attached to the copyboard and travel along with the copyboard. However, they may also be adjusted within certain other limitations to provide for even illumination of the copy. Figure 5-33 shows how the lamps may be positioned in relation to the copyboard to prevent glare or dark areas. To check for even illumination, turn on the lamps and hold an object centrally in front of the copyboard. The light is balanced when the shadows on both sides of the object have the same tone. You might need to adjust one or more of the lamps in order to achieve this balance.

You must remember, of course, that a change in the lighting arrangement can affect the amount of light being reflected from the copy into the camera. If you shift the lamps, you might have to change your exposure time. Exposure time should be calculated according to the law of inverse squares. (Refer to fig. 5-19.)

Some camera operators use exposure meters for finding the light intensity on the copy to aid them in determining the proper exposure time. You have also seen how light-integrating devices attached to the copyboard of some cameras determine the amount of light reaching the copy and automatically control the length of the exposure.



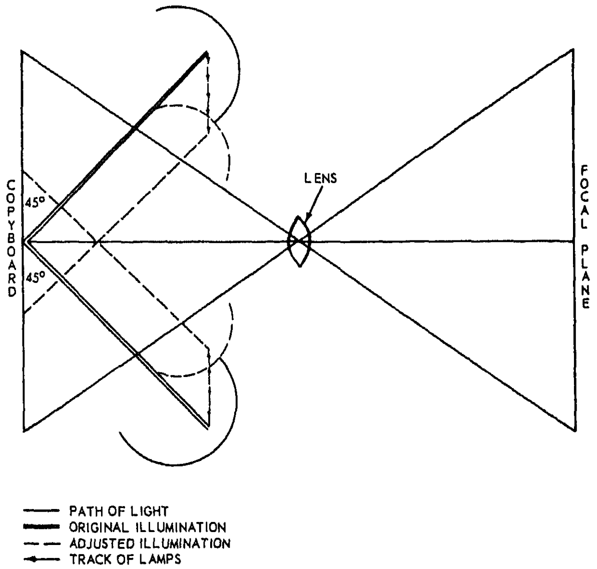
57.85

Figure 5-33.—Positioning camera lamps. Remember that each change in the distance or angle of the lamps affects the amount of light reflected from the copyboard into the camera. Exposures vary directly as the square of the distance from the copy to the lamp.

CAUTION

Never look directly into the lamp. The light produced by various types of camera lamps can damage the human eye. When you replace or adjust the light source, ensure that the power is turned OFF.

ILLUMINATION FOR LARGE COPY.—You will notice also in figure 5-33 that the camera lamps are positioned at a 45-degree angle to the copyboard. This is the generally accepted normal positioning of the lamps. Another generally accepted norm is a distance of 3 feet from the lamp center (point of arc, midpoint of xenon tube, and so on). Basic exposures are commonly calculated on the basis of copy illuminated at 1:1 and focused at an aperture of f/22. For most of your work, this positioning of the lamps will prove satisfactory. However, there may be occasions when you will be required to photograph a large piece of copy and when the usual exposure will prove unsuitable because of uneven lighting. As you can see in figure 5-34, light from the outer edges of the copyboard must travel farther to



57.587

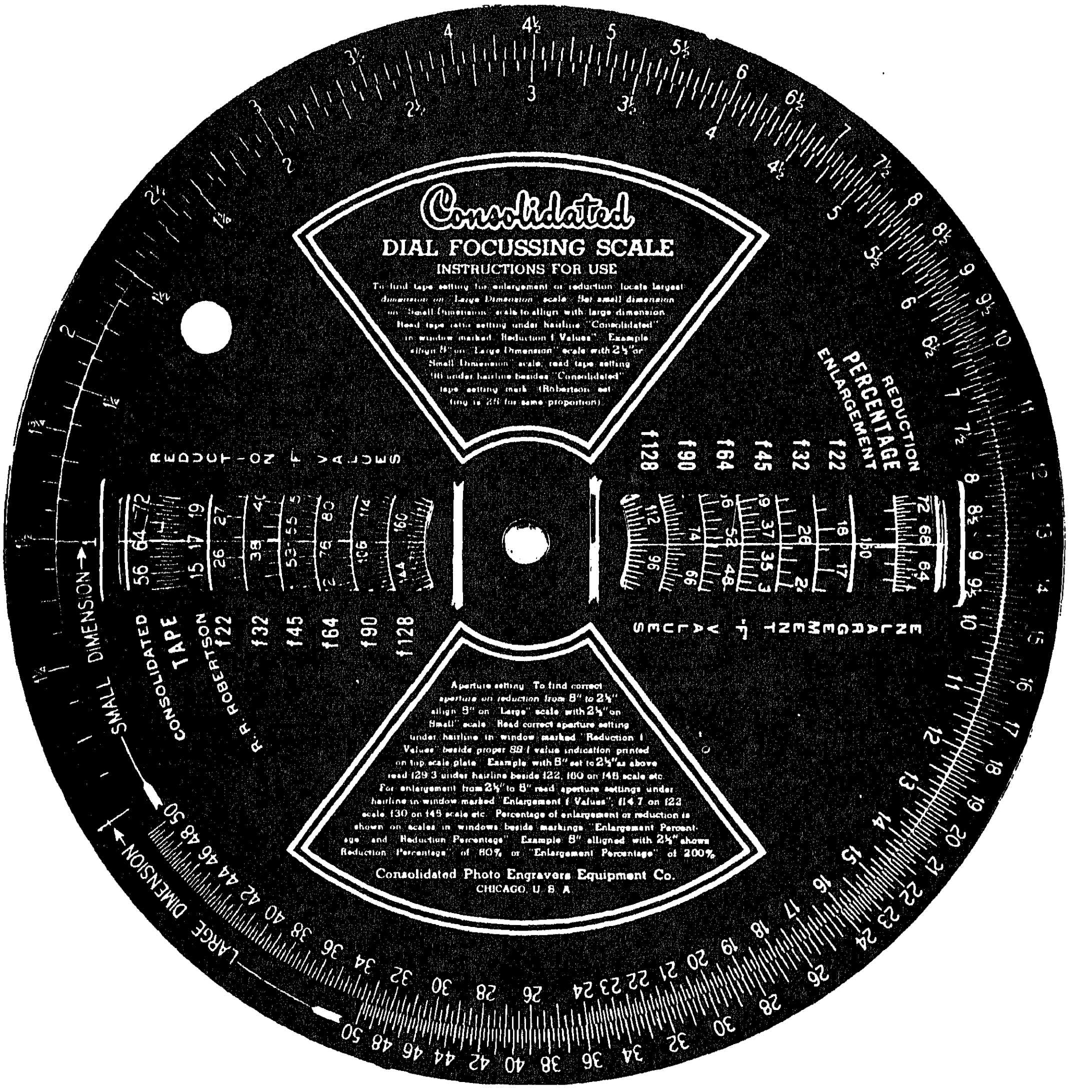
Figure 5-34.—When photographing large copy, you may get better results if you move the lights until their beams intersect at a point equal to one third of the distance from the copyboard to the lensboard.

reach the film than does light from the center. As light travels this increased distance it can become weaker along the edges and might result in underexposure of these areas of the film. You can correct this condition by adjusting the camera to the correct focus, using the normal f/22 aperture. Then replace the copy with a sheet of white paper. Keep the lamps at a 45-degree angle, but move them toward the center until the light beams from the lamps intersect in front of the copyboard. Balance will generally be achieved when the light beams cross each other at a point approximately one-third of the distance from the copyboard to the lensboard. (See fig. 5-34.) Inspect the lighting on the ground glass to see if the lighting is distributed evenly from the center to the outer edges.

As you determine the appropriate arrangement of lamps for a particular size of copy, you should record that information for future reference. Do not forget that the exposure time might have to be adjusted to compensate for the change in illumination.

Focusing Controls

The copyboard and lensboard are moved into position (focus) with handwheels from the rear of the camera. To find the focusing points, the camera operator uses a scaling wheel to determine the enlargement or reduction percentages of the copy to be photographed. Figure 5-35 illustrates a typical scaling sheel. When the percentage has been determined, the copyboard



To find tape setting for enlargement or reduction locate largest dimension on "Large Dimension" scale. Set small dimension on "Small Dimension" scale to allign with large dimension. Read tape ratio setting under hairline "Consolidated" in window marked "Reduction f Values". Example: allign 8" on "Large Dimension" scale with 2½" or "Small Dimension" scale, read tape setting 98 under hairline besides "Consolidated" tape setting mark. (Robertson setting is 2ff for same proportion)

Aperture setting. To find correct aperture on reduction from 8" to 2½" allign 8" on "Large" scale with 2½" on "Small" scale. Read correct aperture setting under hairline in window marked "Reduction f Values" beside proper 88 f value indication printed on top scale plate. Example with 8" set to 2½" as above read f29.3 under hairline beside f22, f60 on f48 scale etc. For enlargement from 2½" to 8" read aperture settings under hairline in window marked "Enlargement f Values"; f14.7 on f22 scale, f30 on f45 scale etc. Percentage of enlargement or reduction is shown on scales in windows beside markings "Enlargement Percentage" and "Reduction Percentage". Example: 8" alligned with 2½" shows "Reduction Percentage" of 80% or "Enlargement Percentage" of 200%.

Consolidated Photo Engravers Equipment Co.
CHICAGO, U. S. A.

57.81X

Figure 5-35.—Scaling wheel.

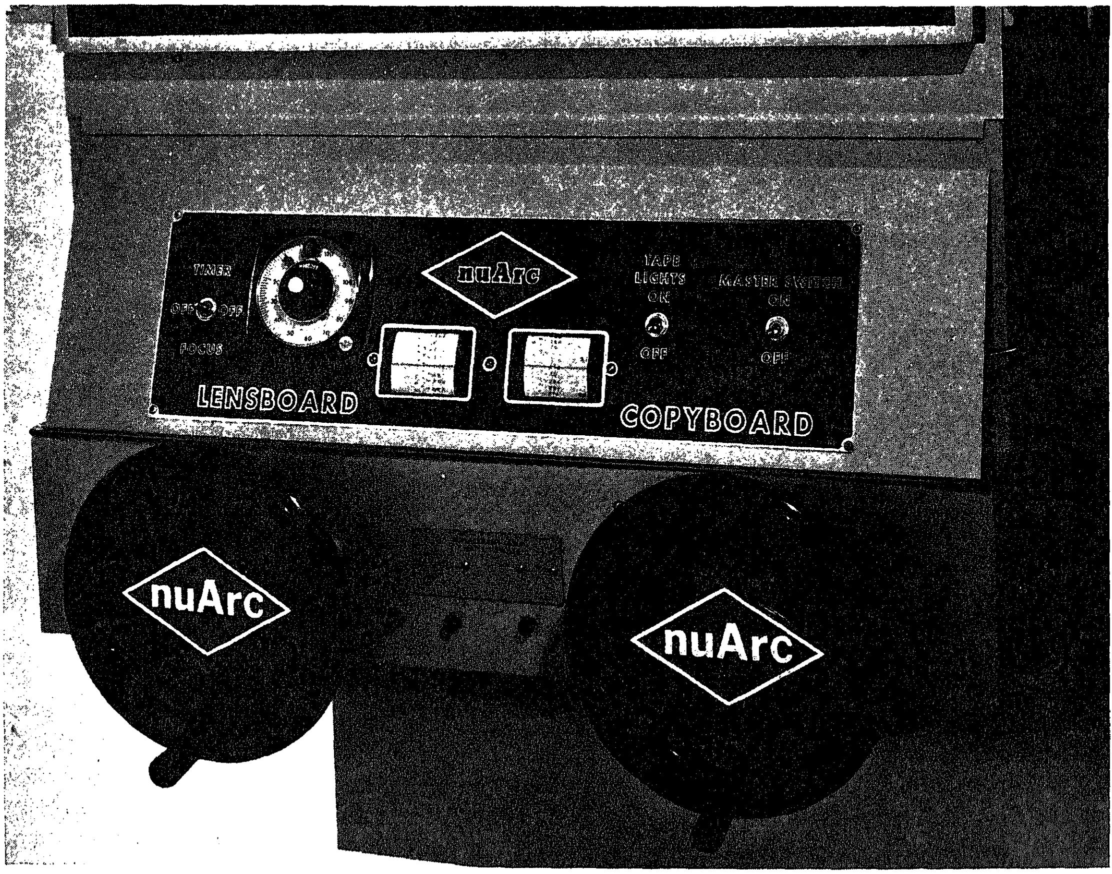


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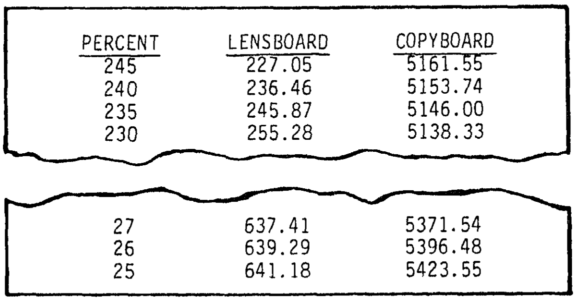
Figure 5-36.—Focusing controls. The lensboard is positioned by the left handwheel; the copyboard by the right handwheel. Metal tapes extend from the copyboard and lensboard through the viewing window which enables the camera operator to accurately position them.



PERCENT	LENSBOARD	COPYBOARD
245	227.05	5161.55
240	236.46	5153.74
235	245.87	5146.00
230	255.28	5138.33
27	637.41	5371.54
26	639.29	5396.48
25	641.18	5423.55

57.82X

Figure 5-37.—Lens calibration chart.

and lensboard are positioned with the handwheels, shown in figure 5-36.

Metal tapes extend from the copyboard and lensboard through an indicator window. The tapes are inscribed with percentage markings to indicate when the copyboard and lensboard are in focus for the size desired. The tapes are read through this viewing window. (See fig. 5-36.)

To focus the camera for a same-size shot, you should place each tape at the 100-percent marking. For an enlargement of 25 percent, you should set the tapes at 125 percent, and so on.

Many larger process cameras are equipped with vernier dials and counters, which are electrically driven. To focus with this system, the camera operator converts the percentages to a series of numerals, using a lens calibration chart like the one shown in figure 5-37.

NOTE

Figure 5-37 illustrates a calibration chart for one specific lens. If you switch to a lens with a different focal length, you must use a different chart to determine your lensboard and copyboard positions, or you must focus on the ground glass by sight.

Look at the last line in figure 5-37; the setting for the lensboard is 641.18, and the setting for the copyboard is 5423.55. To position the lensboard, press the switch that drives the lensboard until 641 appears on the revolution counter. Then turn the small wheel with your fingers to bring the proper hundredths reading into the window. The same procedure is followed for the copyboard setting. Vernier dials and revolution counters are illustrated in figure 5-38.

An understanding of a simple focusing formula will help you to find the positions for your lensboard quickly when you are focusing by sight.

$$\text{Copy to lens} = \text{focal length} \times \left(1 + \frac{1}{\text{magnification}}\right)$$

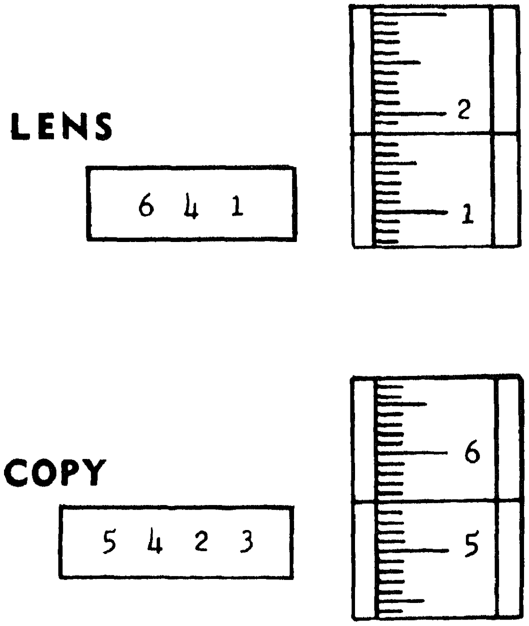
$$\text{Ground glass to lens} = \text{focal length} \times (1 + \text{magnification})$$

For example, if you are using a 16-inch lens and have the camera set for a same-size shot, the focusing distances would be calculated as follows:

$$\text{Copy to lens} = 16 \times \left(1 + \frac{1}{1}\right) = 16 \times 2 = 32 \text{ inches}$$

$$\text{Lens to film} = 16 \times (1 + 1) = 16 \times 2 = 32 \text{ inches}$$

$$\text{Copy to film} = 32 + 32 = 64 \text{ inches}$$



57.83X

Figure 5-38.—Vernier dials and counters.

Focusing distances for copy to be reduced one-half would be calculated as follows:

$$\text{Copy to lens} = 16 \times \left(1 + \frac{1}{\frac{1}{2}}\right) = 16 \times 3 = 48 \text{ inches}$$

$$\text{Lens to film} = 16 \times \left(1 + \frac{1}{2}\right) = 16 \times 1\frac{1}{2} = 24 \text{ inches}$$

$$\text{Copy to film} = 48 + 24 = 72 \text{ inches}$$

Distances for copy to be enlarged 200 percent (twice original size) would be calculated as follows:

$$\text{Copy to lens} = 16 \times \left(1 + \frac{1}{2}\right) = 16 \times 1\frac{1}{2} = 24 \text{ inches}$$

$$\text{Lens to film} = 16 \times (1 + 2) = 16 \times 3 = 48 \text{ inches}$$

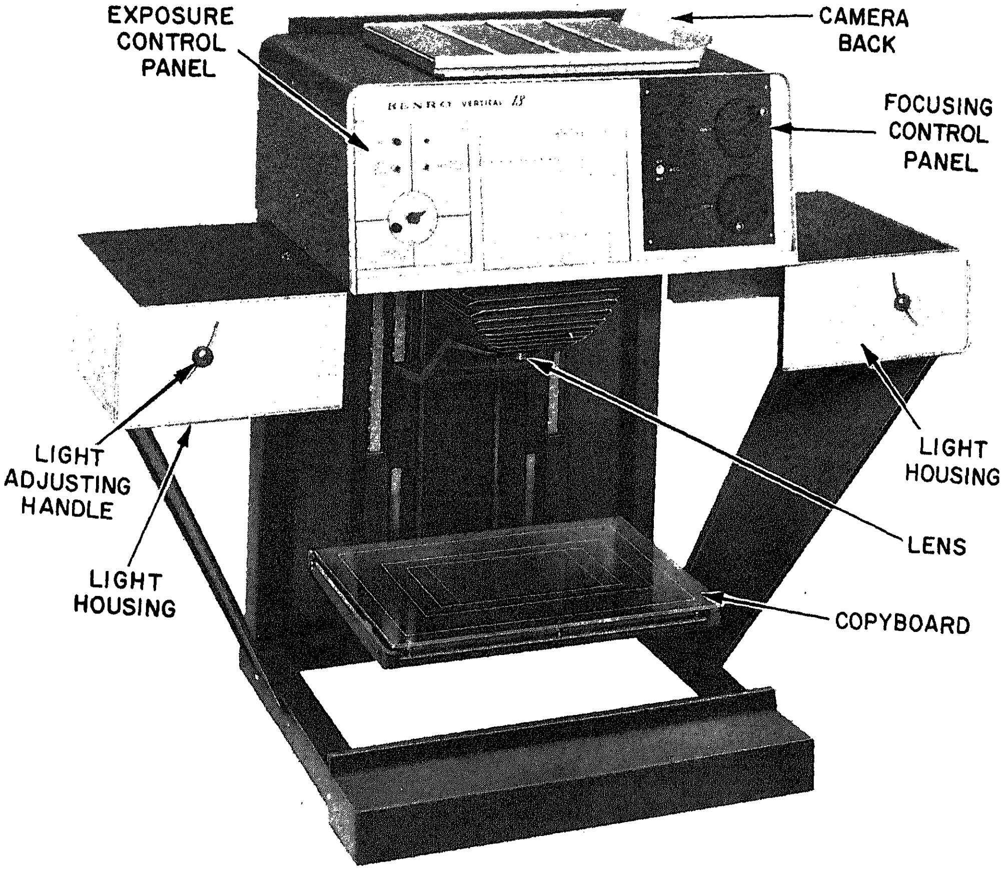
$$\text{Copy to film} = 48 + 24 = 72 \text{ inches}$$

You can use the rated focal length of your lens for calculating purposes. For approximate distances the center of the lens should be taken as a point for all measurements, although in exact calibrations two theoretical points within the lens, known as nodal points, must be used. While these formulas will help you to find the approximate positions for your copyboard and lensboard, further focusing on the ground glass may be necessary. Critical or precision focusing should always be done with the lens opening stopped down, and the image on the ground glass should be examined with a magnifier.

VERTICAL PROCESS CAMERAS

Up to this point, we have discussed primarily the horizontal process camera. Now let's take a look at the *vertical* process camera to see how it compares to and differs from the horizontal camera in their components and operation.

As an example, the Kenro camera, shown in figure 5-39, is a vertical process camera. It is similar to the horizontal camera in many respects. The position for the camera back is fixed, but you can move the lensboard and copyboard during focusing operations. Some models of this camera will enlarge 200 percent and reduce 50 percent; others enlarge 300 percent and reduce 66 percent. Of course, you can extend the range of enlargement or reduction by using auxiliary lenses, if necessary.



57.86X

Figure 5-39.—Vertical process camera.

The copyboard will take copy up to 18 by 24 inches. The glass frame is hinged at the back and can be opened for insertion of the copy. You should position the copy according to the reference lines on the bed of the copyboard. A pressure back holds the copy tight against the glass when the frame is closed.

As we further discuss the Kenro camera, refer to figure 5-39 for identification and location of its parts.

The copyboard and the lensboard are in the same relative position as on a horizontal process camera.

Although the camera back is usually equipped with a ground glass, which is removed from the camera when it is not in use, focusing is generally done mechanically rather than visually. When focusing, you should use the circular scale that comes with the camera to find the percentage of reduction or enlargement required. Once you have found the percentage, consult a table provided by the camera manufacturer to find the setting for your copyboard and lensboard. Then turn the handwheels on the focusing control panel until you reach the proper numbers on the revolution counters.

The vertical process camera may be equipped with a vacuum back or stayflat back. If the vacuum back is used, it cannot be removed from the camera for loading, so the camera must be housed in the darkroom. If the stayflat back is used, the camera can be housed in a separate room because the stayflat back is detachable and will be taken to the darkroom for loading.

Some models of this camera will take film as large as 18 by 24 inches, and others take film up to 14 by 18 inches.

The camera lights are contained in the light housing. On some cameras, each housing has three sockets. Three-hundred-watt flood lamps are used in the end sockets, and a ruby (or blue) safelight is used in the two center sockets. When you are setting up the camera in the darkroom, the exposure control panel switch is used to operate the center lights independently.

Some cameras use a different lighting system. On these cameras, lighting is provided by four 500-watt iodine quartz lamps and an intensity booster. You can set the lights for normal or intense lighting with a switch on the control panel. You should use normal brightness during focusing, then turn the lights to high during the exposure.

Handles on the housing enable you to change the angle of the lights, if necessary, to provide for more even illumination.

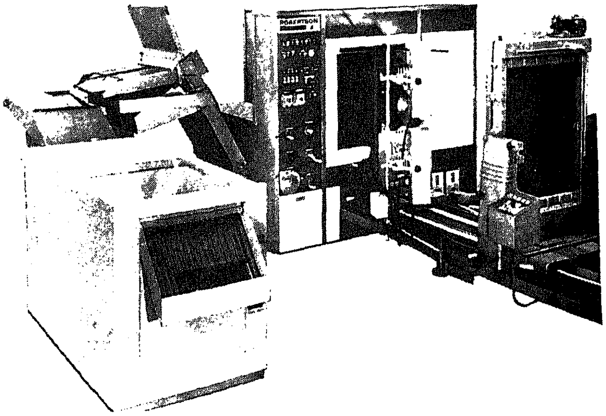
A device known as the Density Modulator is available for Kenro cameras. It consists of a lighting system located inside the copyboard so that light passes through the copy as the job is being photographed. This is designed to eliminate shadows from creases, paste-ups, and overlays, making it unnecessary to cover shadow lines that could appear in negatives. It also provides back lighting for copying film positives and color transparencies.

The Density Modulator has its own reset timer control and relay circuits. It can be operated independently or synchronized with the standard light system of the camera.

AUTOMATED CAMERAS

Automated cameras are designed both vertically and horizontally. These cameras enable the camera operator to load the film, make the exposure, and develop the film in one continuous operation. (See fig. 5-40.)

Some automated cameras are fed from a roll of film that is automatically cut to the proper length before each exposure; others use regular sheet film. The camera operator selects the size of the film, and the film is automatically brought into contact with the vacuum back. If tone copy is involved, the camera operator moves a contact halftone screen into place, sets the lens aperture, and makes the exposure. After the exposure, the camera operator flips a switch to set the camera on automatic feed.



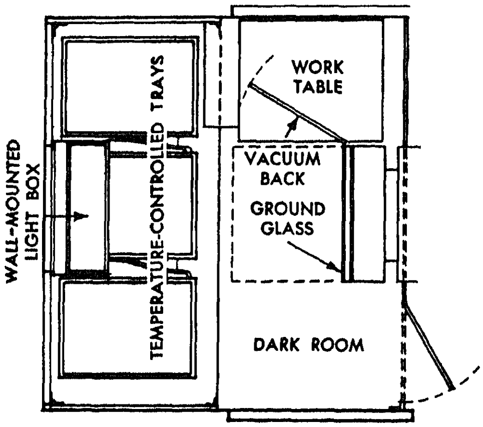
57.589X

Figure 5-40.—Automated camera.

A film-transporting device picks up the exposed film from the vacuum back and carries it to an automatic film processor located in the darkroom. The processor automatically develops, fixes, washes, and dries the film in a cycle of about 10 minutes. Film can be fed into the processor as fast as exposures can be made. The camera controls are located outside the darkroom, and the processor can be positioned to deliver the dried negative either inside or outside the darkroom.

DARKROOM

A darkroom floor plan is shown in figure 5-41. The best floor plan for you, however, will depend on your empty room layout and the equipment you plan to install. Also you must take into account the smooth work flow in your darkroom.



57.89

Figure 5-41.—A darkroom floor plan.

With few exceptions, all photographic processing is done in a lighttight room called a darkroom. There are usually two lighting systems in a darkroom: a normal white light circuit that is used when film is not being processed, and another circuit for special lights that must be used when film is being processed. The term *safelights* is used to describe these special lights. Safelights will be discussed in detail later in this chapter.

Because photographic materials and processing are readily affected by changes in temperature, an air-conditioned darkroom is required. However, if the air-conditioner is not working, the darkroom should be serviced by at least a filtered blower and a fresh-air vent. Another requirement for a properly equipped darkroom is fresh running water.

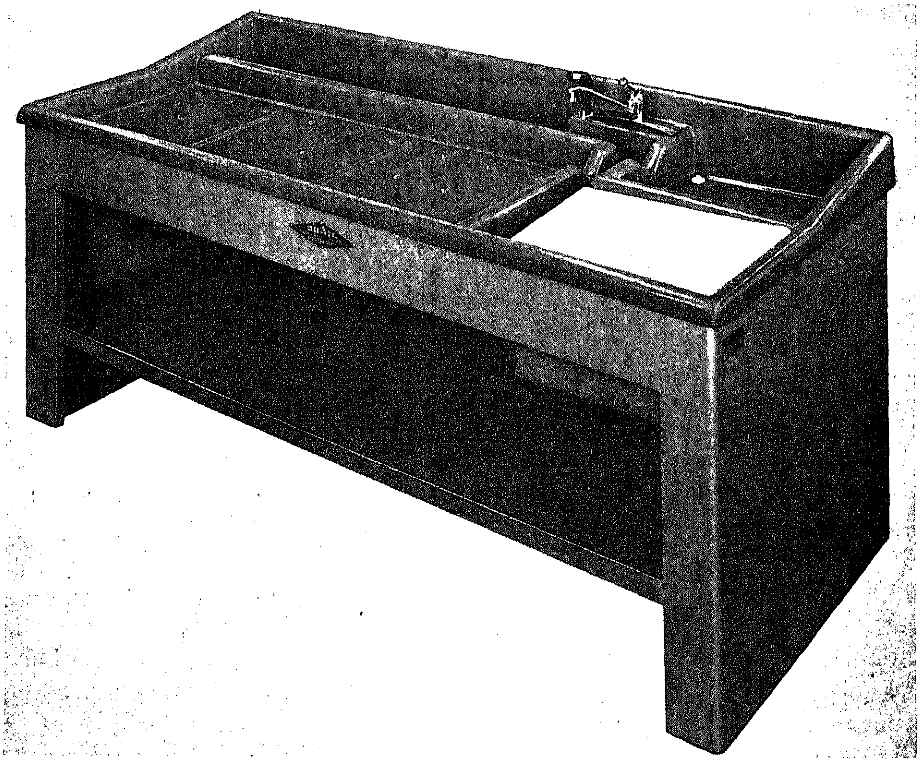
The darkroom also serves as a storeroom for photographic materials. Because film must be kept cool, darkrooms are either air conditioned or equipped with a refrigerated storage area.

SINKS

One type of sink used for film processing is depicted in figure 5-42. As you can see, the sink has room for three trays of processing solutions. On the right is a viewing glass where the negatives may be examined. The area at the bottom can be used as a storage area.

Another type of darkroom sink is temperature-controlled. This type of darkroom sink is preferred because it ensures that a constant temperature of the processing solutions is maintained. In addition, the temperature-controlled sinks may have a refrigerated compartment below where film can be kept.

All darkroom sinks should be thoroughly cleaned at the end of each day. Many expensive sinks have been ruined because they were neglected. The water bath in the sink collects chemicals that will corrode if they are allowed to stand. Never attempt to adjust the refrigerating system of temperature-controlled sinks. That is a job for the engineering or repair department personnel.



57.90X

Always make sure the power is secured when the sinks are empty. Negative-viewing attachments must be inspected often for leaks that would allow water from the sink to reach the wiring and cause an electrical hazard.

FILM PROCESSORS

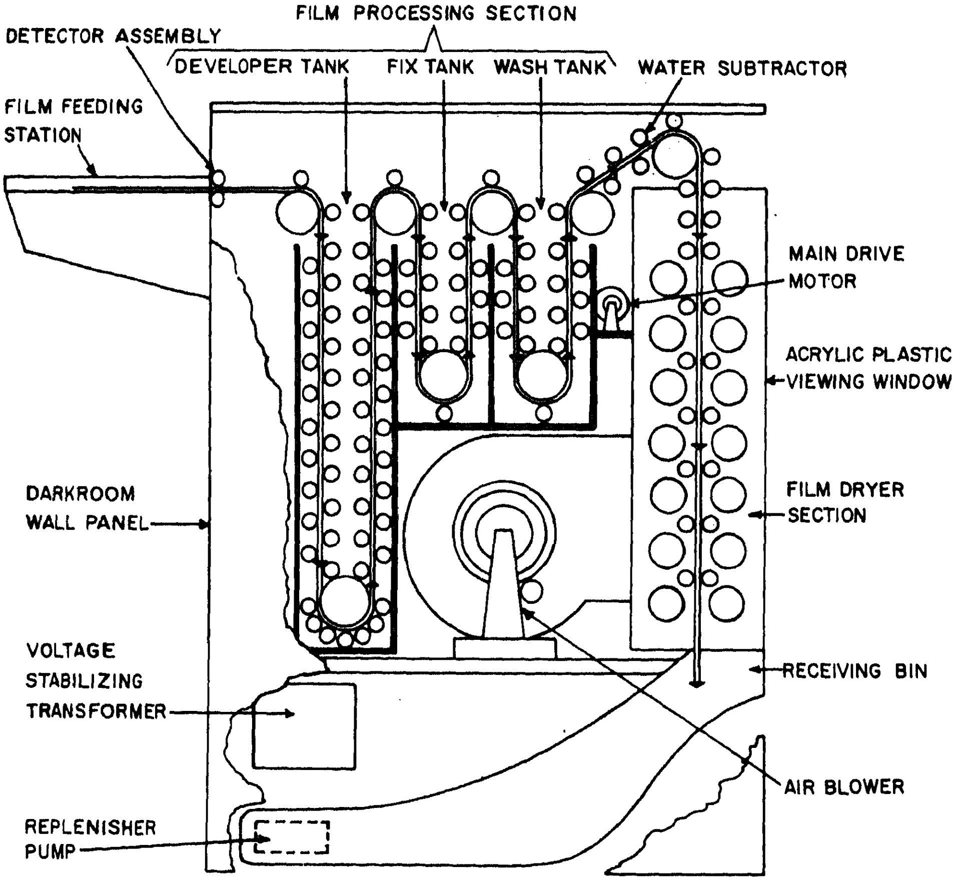
To process film automatically, camera operators in many large shops use film-processing machines similar to the one shown in figure 5-43. These machines were mentioned earlier in connection with the automated camera. However, they are not a part of the automated camera. Film processors are a separate unit and may be used in any darkroom.

After the film is exposed, the camera operator removes it from the camera and inserts it into a slot in the processing machine. Rollers or belts then catch the film and draw it first through a tank containing developer, then through a fixing bath, and finally through a rinse tank of plain water. The film then enters a drying section where it is dried with warm air before it is ejected through a slot on the other side of the film processor. Depending on the film processor and the kind of film used, the machine takes from 5 minutes to 30 minutes to complete its operation. The average time for lithographic film is about 6 minutes.

DENSITOMETERS

Many darkrooms, particularly those that produce a large volume of halftone negatives or color-separation work, are equipped with an instrument called a densitometer. A densitometer is used to measure accurately the density (darkness) of negatives or opaque copy, such as photographs.

Areas of the negative or photograph are light or dark according to the density or concentration of the small, black, metallic silver particles



113.70X

Figure 5-43.—Film processor.

deposited on an acetate or paper base. If the silver particles are extremely concentrated, they will create a dark tone with high density; and if they are sparse, they will create a light tone with low density. When you are working with opaque copy, such as a photograph, the density is called reflection density because you are dealing with the amount of light *reflected* from the image areas of the print. In the case of negatives, the density is called transmission density because you are dealing with the amount of light passed (or *transmitted*) through the negative. The density in halftones is sometimes called integrated tone density, because it depends not only on the size and opacity of the dots but also on the clear space around them. The density of the individual dots on the negative might read as high as 3.0 on a densitometer, but the transparent, open spaces around the dots subdue their tone so that the integrated tone density will be considerably less. A 90 percent highlight dot, for example, might have an integrated tone density reading of 1.0, and a 10 percent shadow dot might have a reading of 0.05.

The densitometer is an instrument designed to measure the different tone areas and express the measurements in numbers, so that the tone areas can be duplicated. You can determine the density range of a negative, for example, by taking a reading of the extreme highlights and extreme shadows and then subtracting the shadow reading from the highlight reading.

Some densitometers are designed to measure the transmission densities of negatives; some are designed to measure the reflection densities of opaque copy, such as photographs; and some are designed to measure both. These combination densitometers, as they are called, are generally used in the camera department, since the camera operator deals with both negatives and opaque copy. Densitometers can be divided into two general categories: visual (or optical) and photoelectric.

The visual (or optical) densitometer is simple in design and reasonable in cost. It consists of a system of lenses and mirrors, which bring together the tone to be measured, and a control tone, which is used for comparison purposes. The densitometer operator adjusts the control tone until the two tones match and then reads the density from a scale. Although the visual densitometer is simple to operate, it is not considered as accurate as the electronic densitometer because it depends largely on the visual judgment of the operator.

So-called photoelectric densitometers depend on a photoelectric cell or similar detector to determine the intensity of the light. For transmission density measurements, the negative is placed between a beam of light and the detector, and the reading is taken from a meter calibrated in density values. For reflection density measurements, the copy is illuminated, then the detector head is passed over the areas to be measured, and a direct reading is taken from the meter. Most photoelectric densitometers are of the combination type.

The densitometer is used extensively in halftone color-separation work. To find the density range of negatives, you should take readings from highlight and shadow areas and subtract the smaller number from the larger number. The density range should not vary beyond certain limits from one negative to another in a set of balanced color-separation negatives.

In black-and-white halftone work, the camera operator can use a reflection densitometer to find the density range of the copy and can use the range as a basis in determining exposures. When the camera operator uses a conventional screen, the densitometer identifies a 50 percent density because the dots are square. However, if the camera operator attempts to judge densities by eye, the judgment may be off by as much as 10 percent or more. For this reason, you must ensure that the densitometer is accurate.

The photoelectric densitometer is used by the camera operator to determine the density of a negative. Before taking the reading, the operator calibrates the densitometer with a test strip of known density values. The negative to be read is placed between the light and the detector. The resultant reading is obtained from the meter scale, which is calibrated in density values. Some models eliminate the meter scale by giving the density value in digital display form.

The head containing the photoelectric cell can be removed from some densitometers and moved to various positions on the copyboard or ground glass of the camera so that illumination can be checked for evenness. The photoelectric cell head can also be used as an illumination meter when filter factors and exposures are being calculated.

Besides its use in the camera departmen[illegible] the densitometer may also be used in the pres[illegible]om and plate-making room and for eva[illegible]ting colored inks and papers.

SAFELIGHTS

Photographic papers and film are sensitive to almost every kind of light if exposed to it long enough. For practical purposes, however, you can handle photographic papers and film under certain colored lights in the darkroom. These lights are called safelights. The type of safelight required depends on the kind of photographic material (films and photographic papers) you are handling. (See fig. 5-44.)

Since photographic materials cover a wide range of sensitivity to light and color, a corresponding series of safelights is needed. The red (series 1) filter safelight can be used with certain films that are sensitive only to violet and blue colors. (These films are known as monochromatic or color-blind films.) Other films coated with orthochromatic emulsions are sensitive to all colors except red and can be handled safely under a red (series 2) or a light red (series 1 A) safelight. Panchromatic film emulsions are sensitive to all colors and should be processed in total darkness. (Panchromatic film may be inspected under a green light (series 3) after the first few minutes of processing.) Orange and yellow-green lights are usually safe for photographic paper.

NOTE

If you are in doubt as to whether the safelight that you are using is safe for a given type of film, check the specifications printed on the film box or on the specification sheets packed inside the box of film.

Remember to always keep your work at least 3 feet away from the safelight. Light leaks from normal white light, high-wattage bulbs, and bleached lamp filters can fog the film.

Ruby or amber light bulbs are sometimes used for general lighting (depending on the purpose of the darkroom). They should be placed high on the bulkhead or overhead. They are not safe as safelights but will not cause appreciable damage if you keep the work at a satisfactory distance from them.

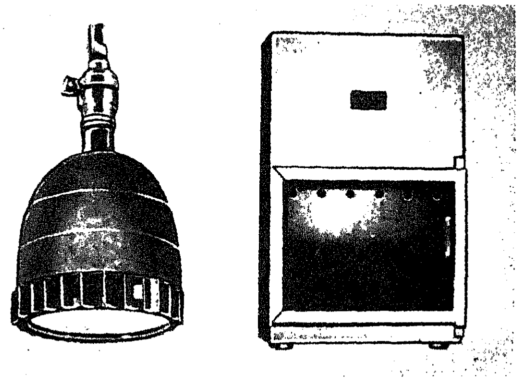

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Figure 5-44.—Safelights.

FILM CABINET

The film cabinet shown in figure 5-45 is typical of those used in darkrooms. The film cabinet has four lighttight drawers for storing loose film and a cabinet beneath for packaged film storage. The top is often fitted with a paper cutter for trimming or cutting film or photographic papers.

FILM DRYERS

After developing and fixing the film, you should wash the negatives in plain water before

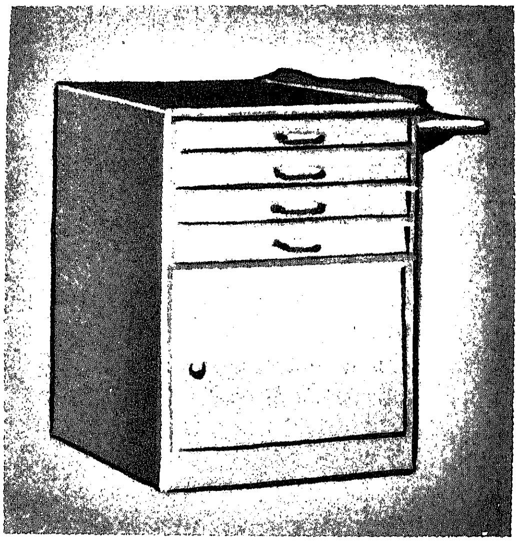
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Figure 5-45.—Film storage cabinet.

drying them. In small shops, film is dried by attaching clips or clothes pins to the film and hanging it on a line—much the same as you would hang clothes on a clothesline.

Many Navy print shops have film dryers installed. The film dryer shown in figure 5-46 will take film as small as 4 by 5 inches and as large as 20 inches wide by any length. It can dry a sheet of 20- by 24-inch film in 24 seconds. It does not have a regular heating unit; however, the pump motors generate a small amount of heat, which is used to dry the film. The temperature of the dryer seldom exceeds 119 °F; the relatively low temperature helps to preserve the dimensional stability of the film. You should allow about 3 minutes for the machine to warm up at the beginning of the day or after a long shutdown period. When you are going to use a dryer, you should make sure that your fixing solution contains hardener, that the solution is not too old, and that the wash water is fresh, cool, and clean.

Feed the film into the machine while it is wet. You do not need to squeegee it, because the excess water is squeegeed off by the rubber rollers as the film enters the machine. This water does not go inside the machine but drips down the rubber feed guide on the front of the machine. The dryer should be placed so that the feed guide is over a sink or a tray, into which the water can drip.

To feed film into the dryer correctly, you should hold the piece of film on both sides (about 2 inches from the leading edge) and pull out so the leading edge is drawn taut. This edge must enter the first rollers squarely. To feed the larger, thin based film correctly requires some practice. Putting at least 20 pieces through the machine in a practice run will enable you to develop a feeding technique.

All films and emulsions do not dry at the same rate. Even the same film will dry more slowly on one day than it will on another, due to the relative humidity of the atmosphere. Normally, when you are handling Estar, Cronar, and the polystyrene bases, you can operate the dryer at a faster speed than you would use when drying some acetate films.

A speed-control knob controls the rate of travel of the film through the machine. Turning the knob to the right speeds up the dryer. You should keep the machine running as fast as is consistent with good drying.

Another knob controls a plate leading from the air intake to the muffler. You have just seen that there is no heating element in the dryer and that the heat is supplied from the pump motors. By pulling the knob out, you can close the damper, and this will cause the air heated by the motors to recirculate. If you push the knob in, the dryer will take in fresh air and will not dry the film as fast.

You should replace the intake filter pad every 3 months or after approximately 250 hours of operation. You should also remove the entire drive and air mechanism for cleaning about every 3 months in normal operation.

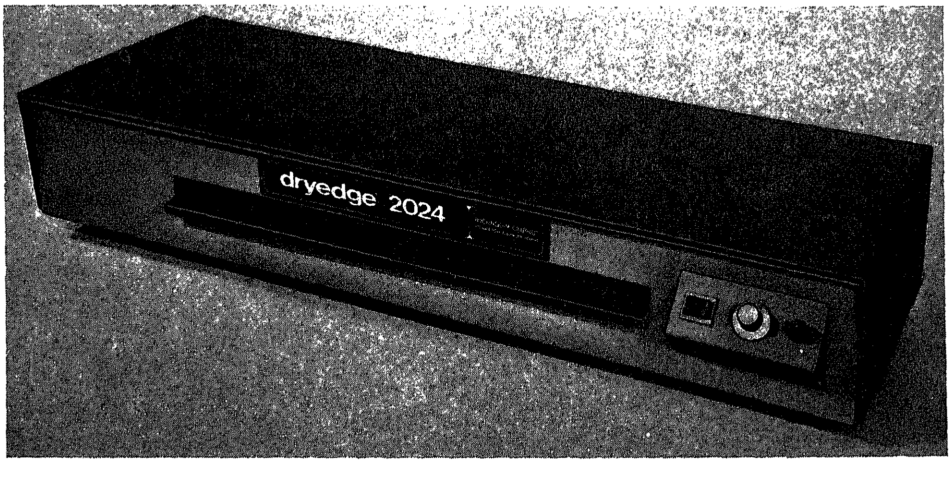

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Figure 5-46.—Dryedge film d

Another type of film dryer is the automatic film dryer shown in figure 5-47. This machine consists essentially of a heating and blowing unit and sets of rollers and belts, which carry the film through the machine and eject it dry and ready for use. The average drying time for a 14- by 20-inch sheet of film is approximately 2 minutes.

The automatic film dryer is generally mounted on the bulkhead over the darkroom sink. The operator feeds wet film into it without squeegeeing off the surplus water. The film must be fed down the center of the dryer, with the leading edge square with the feed-in rollers. The rollers grasp the film and pull it into the machine, squeegeeing off the excess water.

Forced hot air dries the film as it travels along. When the film reaches the top of the machine, the film passes around a drum, which causes it to make a U-turn and emerge from the machine into a receiving tray (on the top of the dryer), dry and ready for use.

A four-button switch is used for regulating the temperature of the machine as well as for starting and stopping the dryer. The buttons on this switch are marked LOW, MEDIUM, HIGH, and OFF. The OFF button not only shuts off the heat but also turns off the drive motors.

The amount of heat required for drying is determined by the relative humidity of the room and the type of film being dried. You should always use the lowest temperature that will dry the film properly. The MEDIUM heat setting is used for the average run of work, and approximately 5 minutes' warm up time is required when the machine is started at the beginning of the day.

Film thinner than 0.004 inch is difficult to feed through the machine, because of curl.

If the film jams in the machine, lift the receiving tray ([A] in fig. 5-48) and remove the air intakes (B) by lifting them out with the handles provided. If the film is wrapped around one of the rollers, lift and pull to the side the slide tension bracket (C) on each end of the roller part (D). Be careful not to lose the bearings on the end of the roller as you lift the roller out to remove the film. Once the film is removed, you can replace the roller by reengaging the tension brackets. Then lower the receiving tray and resume operations.

The air filter is located at the back of the dryer and simply slips in and out. Replacement filters

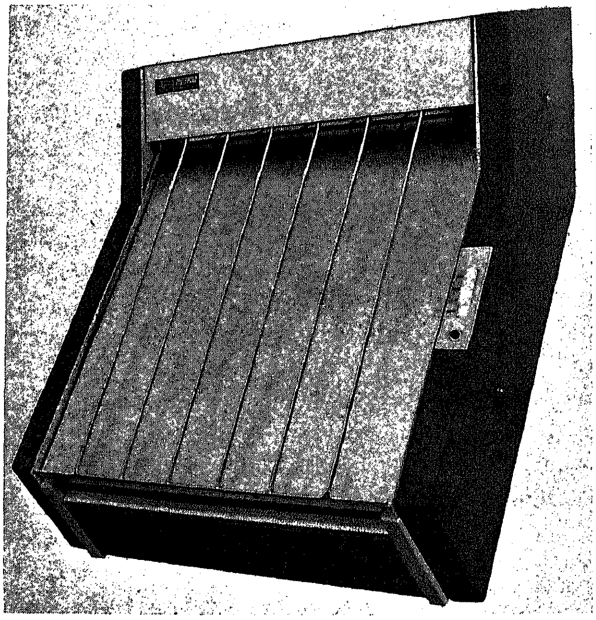

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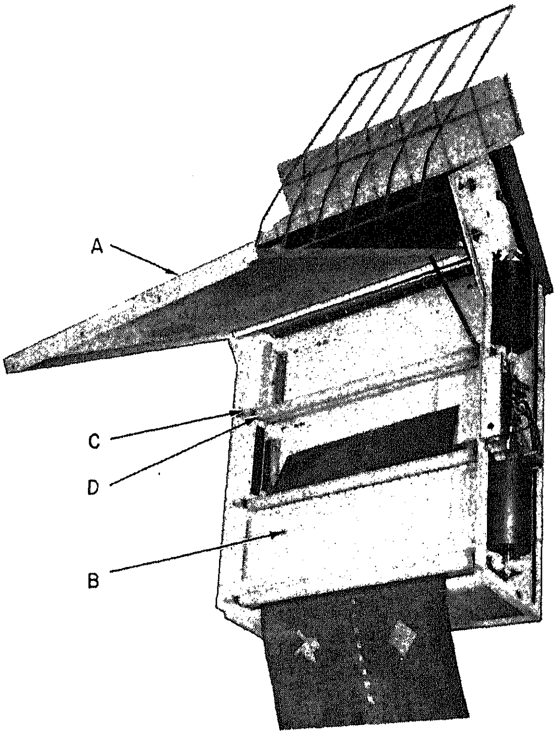
Figure 5-47.—Southwind automatic film dryer.



A. Receiving tray
B. Air intakes
C. Slide tension bracket
D. Roller

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Figure 5-48.—Removing film caught in the dryer.

are of a standard size and are available at most hardware stores.

You should inspect the filter and rollers periodically to see that they are clean. You can clean the rollers with a soft cloth dampened with water. You should also keep the receiving tray clean to avoid the possibility of contaminating the film after it has emerged from the machine.

Not all Navy print shops will have the same types of film dryers we have mentioned; however, all film dryers are similar in operation. But before operating or performing any maintenance on any type of dryer, you should refer to its operator's manual.

TIMERS

The timers shown in figure 5-49 are clocklike devices that can be set to signal the operator when a predetermined time has elapsed. Timers are used in film processing and similar operations. The operator sets the timer by turning a knob to move the dial hand to the figure indicating the desired time and places the timer in operation by depressing the spring-actuated lever on the rear of the timer or by moving a sweep hand to the zero position and releasing the hand. At the time selected, a bell will ring to signal the operator that the time is up.

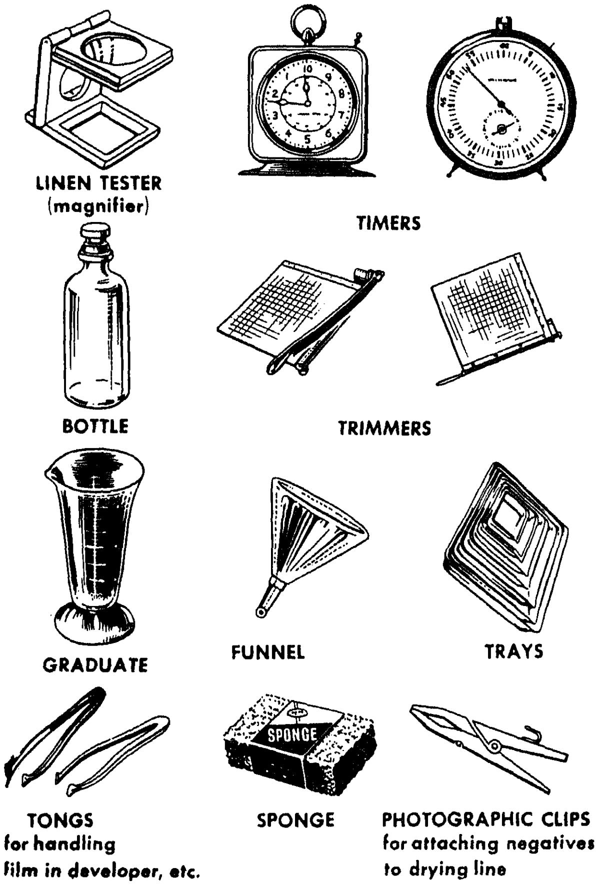
LINEN TESTER (magnifier)
TIMERS
BOTTLE
TRIMMERS
GRADUATE
FUNNEL
TRAYS
SPONGE
TONGS for handling film in developer, etc.
SPONGE
PHOTOGRAPHIC CLIPS for attaching negatives to drying line

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Figure 5-49.—Miscellaneous darkroom equipment.

The operator sets and activates electric timers like those found on the cameras and on photographic enlargers by moving a pointer to the number indicating the desired time and then using a pushbutton switch mounted below the dial. The electric timer terminates the exposure automatically at the completion of the set time. These timers are especially useful when repeated exposures of the same duration must be made.

MISCELLANEOUS DARKROOM EQUIPMENT

Figure 5-49 also shows several miscellaneous pieces of darkroom equipment. Always handle thermometers carefully; they are fragile. High temperatures can burst the bulb, and severe jarring can separate the mercury column. You can sometimes reunite a separated mercury column by swinging the thermometer rapidly with the bulb outward or by heating the thermometer gradually in a pan of water. Graduates, funnels, pans, stirring rods, and trays must be kept spotlessly clean to prevent the chemicals from being contaminated and to prevent dried crystals from flying about in the air.

PHOTOGRAPHIC PRINTING EQUIPMENT

In photolithographic work, you print most of your negatives on metal plates. However, you may also be called on to make positive copies on film or paper. Positive copies on film are known as film positives, and positive copies on paper are known as prints.

These positive copies may be made by either contact or projection printing. Contact prints are made in a printing frame that holds the negative and sensitized material (either paper or film) in perfect contact with one another during the exposure. Projection prints are made with a photographic enlarger.

PRINTING FRAMES

The simplest printing frame consists of a wood, metal, or plastic frame with a glass front and a padded, spring-clamp back. (See fig. 5-50.) Negatives and paper are held emulsion to emulsion between the glass and the back, and the exposure is made when the glass is turned to the light. Such a frame will serve for small jobs, but it is too slow to be of much value if there is much of this type of work to be done.

CONTACT PRINTERS

The contact printer shown in figure 5-51 is more suitable for the average run of work. It consists of a hinged cover, which clamps down over the glass and holds the paper in tight contact with the negative; at the same time, a light inside the box switches on to provide the exposure. The exposure ends when the cover is lifted, although a small ruby lamp remains lighted inside the light box throughout all printing operations. The photographer uses this light in positioning and examining the negatives.

A masking device or frame is used to provide white margins around the prints. This masking device could consist of thin strips of metal, which could be adjusted to accommodate any size of negative or margin. Generally, 1/2-inch margins are allowed for 8- by 10-inch prints, and 1/4-inch margins are allowed for smaller sizes.

The masking device sometimes prevents absolute contact between the negative and the paper. This causes the edges of the image to be blurred. You can eliminate such trouble by using a mask cut from thin black paper instead of the regular masking device.

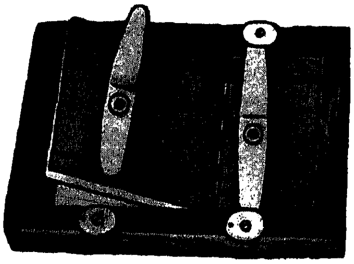

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Figure 5-50.—A printing frame.

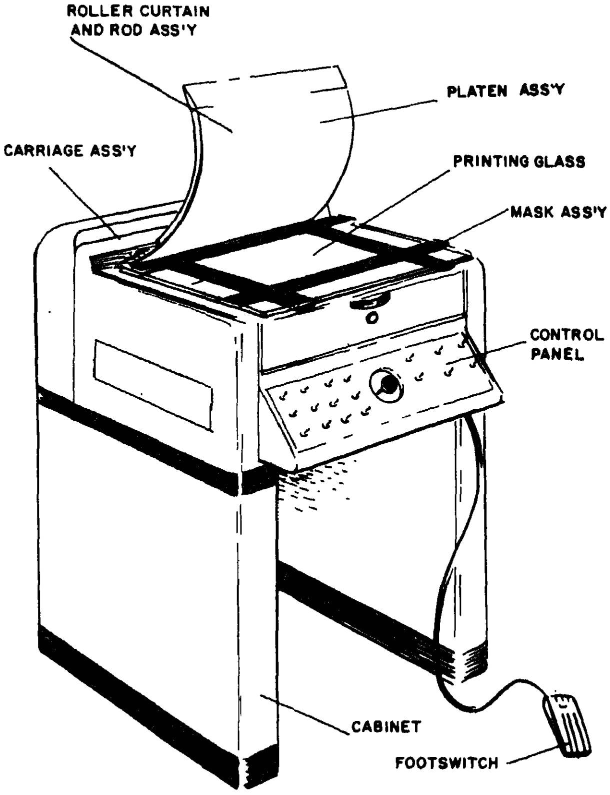

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Figure 5-51.—Contact printer.

VACUUM PRINTERS

The printing frame and contact printer are generally used for making prints on photographic paper only. For positive prints on film, a vacuum printer or a vacuum frame is generally used to ensure the close contact required for fine line and tone work. You will learn more about film positives later in this training manual.

SAFETY IN THE CAMERA AREA AND DARKROOM

Hazardous situations exist when the lithographer is working in the camera area and darkroom with photographic equipment. You must recognize these hazardous situations and eliminate them whenever possible. Safety on the job is your responsibility.

The following are points to remember when you are working in the darkroom:

- Never touch a plug, switch, or any part of an electrically operated machine with wet hands or while standing on a wet deck. Keep a towel handy to dry your hands.

- Ensure that all equipment has been properly checked for safety by the electrical shop personnel.

- Never "jury-rig" equipment to operate it. The use of long extension cords should be avoided. It is easy to trip or stumble over them in the darkroom or even in a well lit room.

- Always read the label on chemical containers to prevent personal injury.

- Clean up all spills immediately.

- Whenever you are replacing components or adjusting equipment, secure the power at its source.

- Don't attempt repairs to motors or switches. That's a job for the electricians.

- Don't lean on the glass of light tables. A severe injury could result.

- Report all accidents to competent authority. The investigation of one accident could prevent others.

- All injuries should be reported to the medical department when they occur. What seems minor when it occurs could develop into something serious without prompt attention.

SUMMARY

In this chapter we discussed the theory of light—what it is, where it comes from, and how it is seen. We also discussed how light enables us to see objects. The principles of photography and how the Navy Lithographer uses them when operating the camera and darkroom equipment were also presented.

Because the photolithographic process camera is important, it was discussed in detail. The camera's copyboard, lamps, and focusing controls, as well as the lenses, filters, lensboard, bellows, ground glass and vacuum back/negative carrier were explained. The horizontal process cameras are larger than the vertical or some automated process cameras. Once you have mastered a process camera, you can, with minimum instruction, become an operator of other cameras, even the automated cameras.

A floor plan or design possibility for setting up a photolithographic darkroom was presented. Sinks, film processors, densitometers, safelights, film cabinets, film dryers, timers, and some other miscellaneous darkroom equipment were introduced. The characteristics and uses of other photographic printing equipment, such as printing frames, contact printers, and vacuum printers, were discussed.

Before working on any Navy equipment, the Navy Lithographer should refer to and study both the operator's manual and the related NAVSEA technical manual.

The all important subject of safety around photographic or darkroom equipment, either electrical or chemical, was discussed. As a lithographer, you should always be aware of unsafe actions or conditions and be prepared to correct them. Never consider safety as being the other person's job.

The information on the operational equipment will be mentioned in other chapters of this training manual.

This chapter has covered most of the equipment you are likely to come across in the darkroom. However, because of the variations found in lithographic establishments, the material here is not applicable to all print shops alike. Nevertheless, it will be to your advantage to study the whole chapter, because sooner or later you will probably come across most of the equipment discussed here.

The subject of photographic materials will be introduced to the Navy Lithographer in the next chapter.

CHAPTER 6

PHOTOGRAPHIC MATERIALS

A designated section of this chapter contains information required for LIC candidates only. This section will be prefaced with For LIC Candidates Only. LI3, LI2, and LI1 candidates do NOT have to read the designated section. However, LIs serving as LPOs may find the information of interest.

Although a study of the effects of light on silver salts had been underway for many years when Joseph Niepce produced the world's first photoengraving in France in 1824, photography as we know it today had not been invented. (See fig. 6-1.)

Of course, Niepce had no negative; instead, he used a proof taken from an original engraving for an image. He printed this image on a metal plate (coated with a solution of asphaltum) by exposing the plate to the sun for several hours. Since he was printing from a positive, a reverse image was produced on the plate. And when he etched the image into the metal, he came up with an intaglio (engraved) image rather than one that stood in relief.

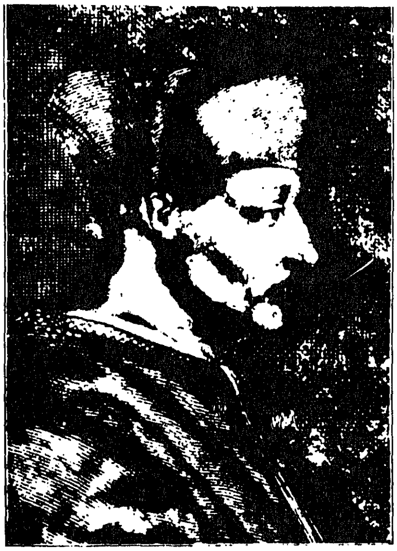

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Figure 6-1.—The world's first photoengraving. Produced in 1824 by Joseph Niepce.

Niepce's son later joined in photographic experiments conducted by L. J. M. Daguerre, who was trying to produce continuous-tone images. (See fig. 6-2.) Finally, in 1839, Daguerre produced the first successful photograph, which he called the daguerreotype.

Although the basic principles of photography have not changed, there have been important changes in photographic materials.

THE CHEMISTRY OF PHOTOGRAPHY

Photography has been described as a scientific art based on chemistry and physics. Chemistry deals with the composition of matter and the changes that occur when substances are taken apart or combined. Physics is the study of energy (light, heat, sound, electricity, and so forth) and its effect on matter. It is not necessary that you have a detailed knowledge of these sciences, but you should be familiar with the fundamentals contained in this chapter to help you understand the photographic processes.

Certain substances, such as carbon, iron, sulphur, oxygen, and so on, are known as elements. Elements are basic matter—they cannot be broken down or divided into other substances by chemical means. All matter—even water and air—is made up of elements or combinations of elements. Elements may be combined in a fixed proportion to form a compound. Water (H_2O) is a compound. It contains two atoms of hydrogen for each atom of oxygen, which makes up one molecule of water. Some combinations are not in fixed proportions, and they are called mixtures. For example, water that contains table salt is a *mixture* of liquid and solid, and the salt-to-water ratio can be varied (within certain limitations) and the mixture will still be salt and water. The air

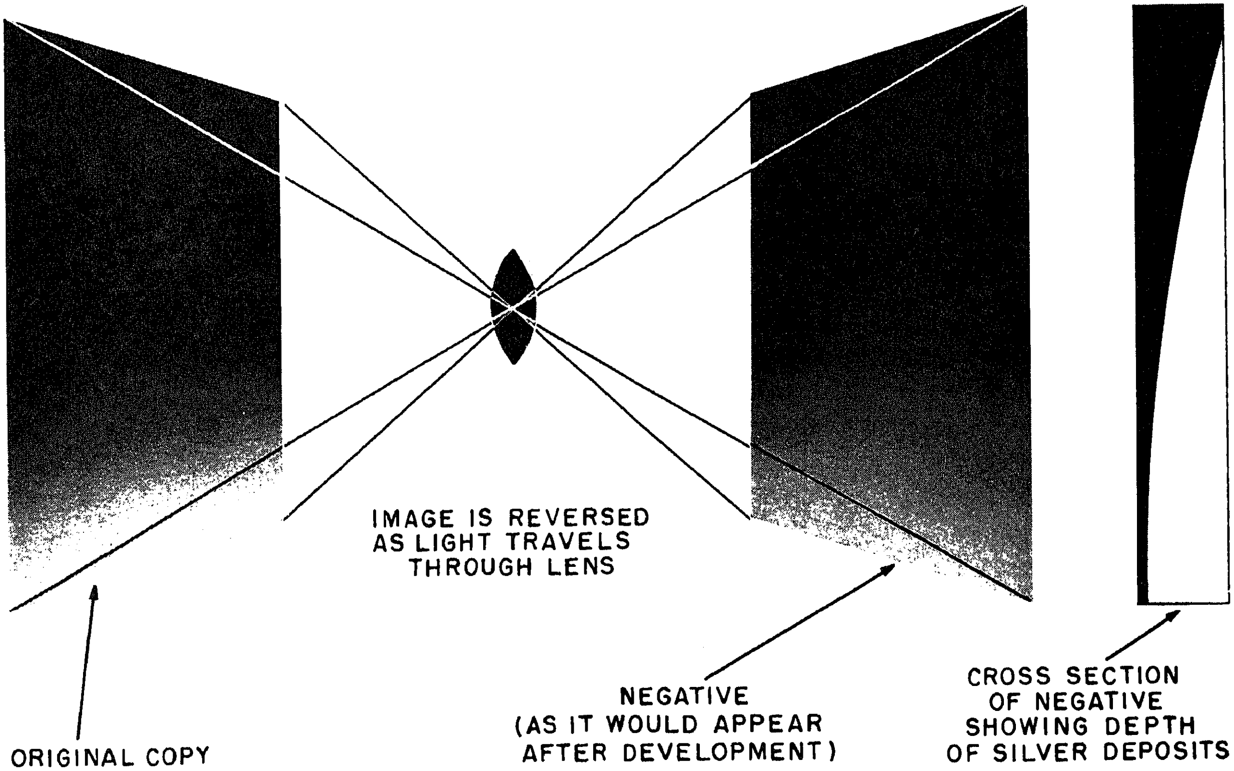
IMAGE IS REVERSED AS LIGHT TRAVELS THROUGH LENS
ORIGINAL COPY
NEGATIVE (AS IT WOULD APPEAR AFTER DEVELOPMENT)
CROSS SECTION OF NEGATIVE SHOWING DEPTH OF SILVER DEPOSITS

113.66

Figure 6-2.—The gradation of tones found in continuous-tone images. The tones in a continuous-tone negative vary with the amount of blackened silver on the film. During the exposure, the light first enters the film emulsion at a point where there are slight surface irregularities. And if there is enough light, or if the exposure is long enough, the light will eventually work its way down to the base of the film. Since more light is reflected from the brightest parts of the subject or copy, the light from these areas naturally penetrates deeper into the emulsion than the light reflected from the shadow and gray middletone areas. As a result, when the film is developed there are heavy deposits of silver in areas that were struck by strong light reflections and thinner deposits—even transparent areas—in places where little light struck the film. The emulsion on photographic paper is similar to that used on the film, so the same thing occurs when the film is printed on the paper. This explains the gradation of tones in photographic prints.

you breathe is a mixture of gases. Air is composed of approximately 78% nitrogen, 21% oxygen, and 1% other gases and water vapor. You may be familiar with polluted air in some large cities. Such air contains much more than the 1% of other gases and, therefore, less nitrogen and oxygen.

The elements are divided into two main classes: (1) metals, such as silver, aluminum, and iron, and (2) nonmetals, such as carbon, oxygen, and sulphur. Each class of elements has certain chemical properties that distinguish it from the other class. These properties are those that deal with the way the elements react with the other elements. (There is a third class of elements, the inert gases, such

The most common chemical reaction is that between oxygen and other substances. This reaction is known as oxidation, and the product of oxidation is known as an oxide. The oxidation of iron results in iron oxide, commonly called rust. Oxidation can result from exposure of a substance to air or water or from contact with another substance that will readily yield oxygen. The substance releasing the oxygen is called an oxidizing agent, and the material causing the release is known as a reducer.

ACIDS, BASES, AND SALTS

Many oxides are soluble in water. The

hydrogen and oxygen) or with hydrogen alone to produce acids. Acids are the opposite of bases in their reaction. Acids are sour to the taste and turn blue litmus paper red.

CAUTION

ACIDS and BASES can be extremely poisonous or caustic and should NEVER be tasted as a test. It is only stated in this manner here because you will find taste as part of their description in other publications.

When an acid and a base, or an acid and a metal, are combined, a reaction called neutralization takes place. Neither acid nor base (nor metal) remain; instead, a new compound is formed. It is called a salt. Sometimes neutralization is not complete. This depends upon the amount of hydrogen present in the two reacting substances (reagents). As you have seen, all acids contain hydrogen, which is usually released in the form of bubbles during neutralization. If all the hydrogen is displaced, the salt will be neutral; if some hydrogen remains, the salt will be an acid salt or a basic salt, depending on which of the reagents was stronger.

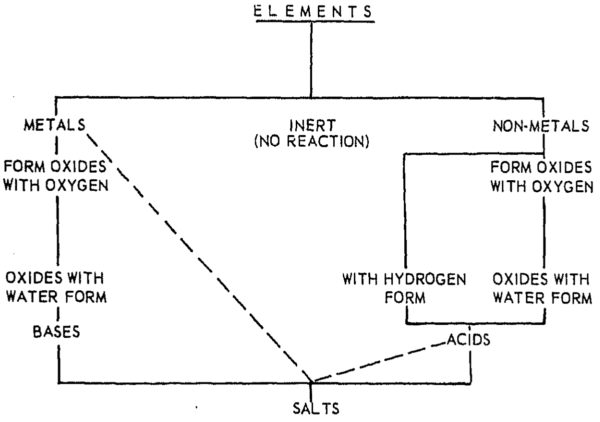

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Figure 6-3.—How elements combine to form other substances.

Figure 6-3 shows how elements combine to form other substances.

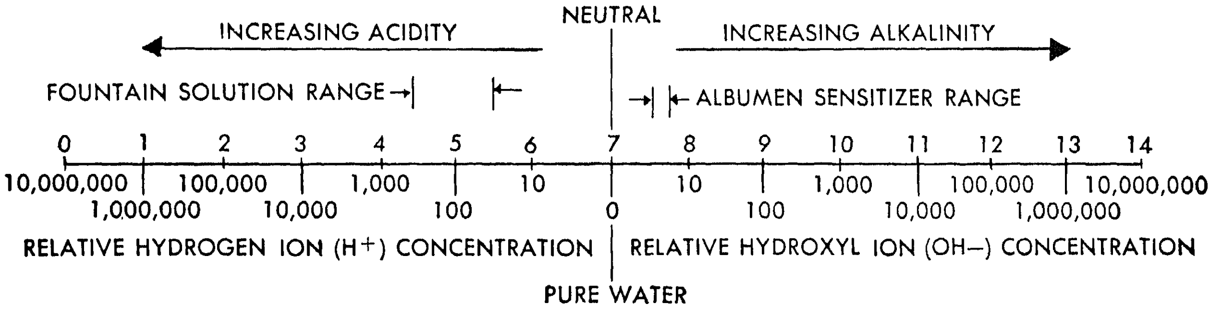
MEASURING ACIDITY AND ALKALINITY

You have seen the reaction of litmus paper to acids and bases. Determining alkalinity and acidity by these means is not accurate as to degree. In the case of a strong alkali or acid, testing by taste could be extremely dangerous.

Since accurate measurements are needed in scientific applications, a system has been devised for measuring the degree of activity of the acid or alkali in solution so that it may be expressed in numerical values. These values may then be recorded and duplicated at any time. This system is known as pH control, and the degree of activity of the acid or alkali in the solution is known as the pH value.

The pH control system is of great importance in all scientific work, and is used extensively by many industries. In lithography, it is used primarily for testing plate-coating solutions and press fountain solutions. You will learn more about each of these solutions later.

The pH values are measured with a scale of numbers ranging from 0 to 14. A pH value of 7 indicates a neutral substance, such as pure water. Values between 7 and 14 denote progressively greater alkalinity, and values between 7 and 0 denote progressively greater acidity. As you can see in figure 6-4, a change of 1 unit of pH value



on the scale indicates a change of acidity or alkalinity of 10 times. For example, a pH of 5 is 10 times as acidic as a pH of 6, and a pH of 0 is 1 million times as acidic as a pH of 6.

There are several methods of determining the pH value of a solution: the electrometric, the colorimetric, and the test strip. The electrometric method is the most accurate; however, it requires sophisticated equipment not normally found in the average lithographic print shop.

The colorimetric method requires that a measured portion of the solution being tested be mixed in a vial with a measured portion of dye. The resultant colored solution is then placed in a device called a comparator, where its color is matched to colored disks of predetermined pH values.

The most common way to determine pH values of solutions is by the test strip method. This method uses a chemically treated paper strip that changes color when it is dipped into the solution being tested. In figure 6-5, you can see the paper strip being obtained from a small plastic dispenser. This dispenser has a printed label showing a color chart that indicates pH values. By matching the color of the moistened test strip to the color chart, you obtain the pH reading of the solution being tested.

There are different ranges of dispensers to meet the varying pH requirements of the pressroom and platemaking departments of a lithographic print shop.

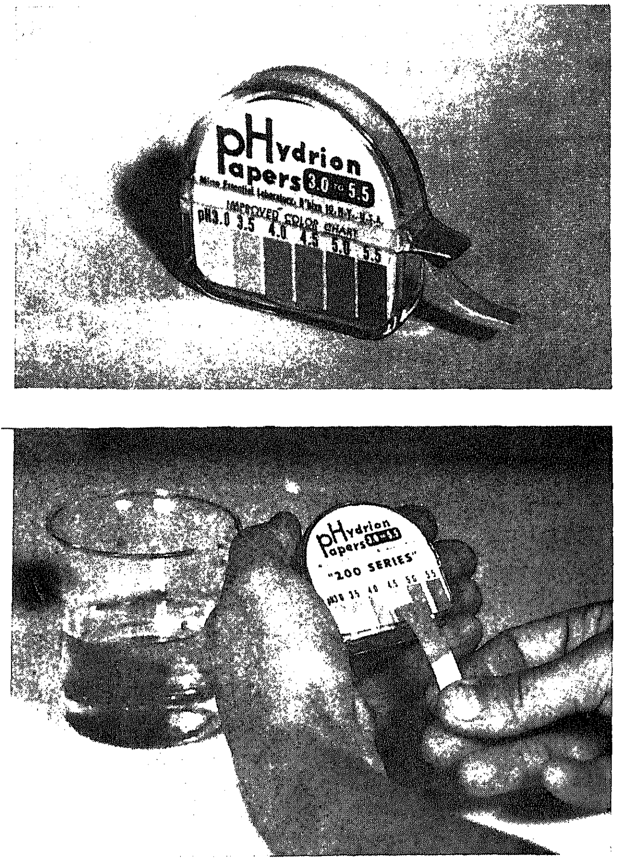


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Figure 6-5.—A paper tape testing dispenser (top). Reading the moistened test strip on the dispenser (below).

CHEMISTRY OF PHOTOGRAPHIC EMULSIONS

Photographic emulsions consist of minute particles of a silver halide (commonly called silver salts) suspended in gelatin. It is the silver halide that is light sensitive; the gelatin simply holds the silver halides in suspension and bonds them to the supporting base.

Silver halides are produced by dissolving bars of metallic silver in nitric acid. When the bars are dissolved in the nitric acid, silver nitrate and hydrogen gas are created. The silver nitrate is then combined with a solution of one of the metallic salts of the halogens. (A halogen is one of a family of elements that readily react with metals to form salts. The three halogens of importance in photography are bromine, chlorine, and iodine. When the silver nitrate is combined with sodium chloride, silver chloride is one of the resulting compounds; a combination of silver nitrate and potassium bromide results in a silver bromide compound; and silver nitrate and potassium iodide result in silver iodide. These compounds are known as silver halides and are insoluble in water.

Of the silver halides, silver bromide is most sensitive to light and silver iodide is least sensitive, with silver chloride in between. Combinations of two or three of the silver halides may be used to produce emulsions of varying sensitivities.

Gelatin for the film base is made by boiling animal tissues. The gelatin is one of a group of organic substances known as colloids. When colloidal materials absorb water, they become gluelike, and they dry to a semisolid.

Refined gelatin is mixed with the halide solution (sodium chloride, potassium bromide, and so forth). Then the silver nitrate solution is added to form the silver halide crystals. The size of the crystals depends upon the speed at which the silver nitrate is added. The slower the silver nitrate is added, the larger the crystals. Size also depends upon the temperature of the solutions. The lower the temperature, the smaller the crystals. As the silver halide crystals are formed, the emulsion mixture becomes light sensitive, and it must then be handled in the dark or in specially controlled light (safelight).

After thorough mixing, the emulsion mixture is cooled. The gelled emulsion is shredded, washed, and then ripened with ammonia fumes and heat. This ripening process causes some of the silver halide particles to unite and form larger crystals. This makes the emulsion more sensitive, since the light travels faster when it is unhampered by a mass of finely divided particles. Light first enters the emulsion at a point where slight irregularities exist along the surface, and, if given enough time, works its way right down to the film base. Large light-sensitive crystals facilitate passage of light and smaller ones retard it. This is why faster films that contain larger crystals are often relatively grainy.

After the ripening, the gelled emulsion is again liquified. The liquified emulsion is then poured onto a supporting base, such as paper or various plastics, where it is allowed to cool. As it cools, the emulsion forms a smooth, hard, flexible surface. A thin layer of gelatin is then poured over the emulsion to form a protective coating.

PHOTOGRAPHIC BASES

You have just seen that paper and various plastics may be used as the base or support for the photographic emulsion. A good base must not shrink or stretch to excess. All materials used as photographic bases change in size somewhat according to the temperature, but some materials react less than others. All materials change with the humidity. For these reasons, the most stable bases are used for negatives and positives in map and chart work, and in precision color work, where extreme close register is required. When properly handled, the low-shrink film bases are sufficiently stable for map and other close register reproduction.

PAPER NEGATIVES

Photographic paper is used in making positive prints (snapshots) and enlargements. In addition, certain types of photographic papers are used for making paper negatives that are used for lithographic printing. Paper negatives with a translucent base are satisfactory for some line work. These papers are usually coated with the same emulsion as film and, if used properly, produce satisfactory results at less cost than film negatives. Paper negatives tend to stretch when wet but are satisfactory in cases where minor variations in size are not important.

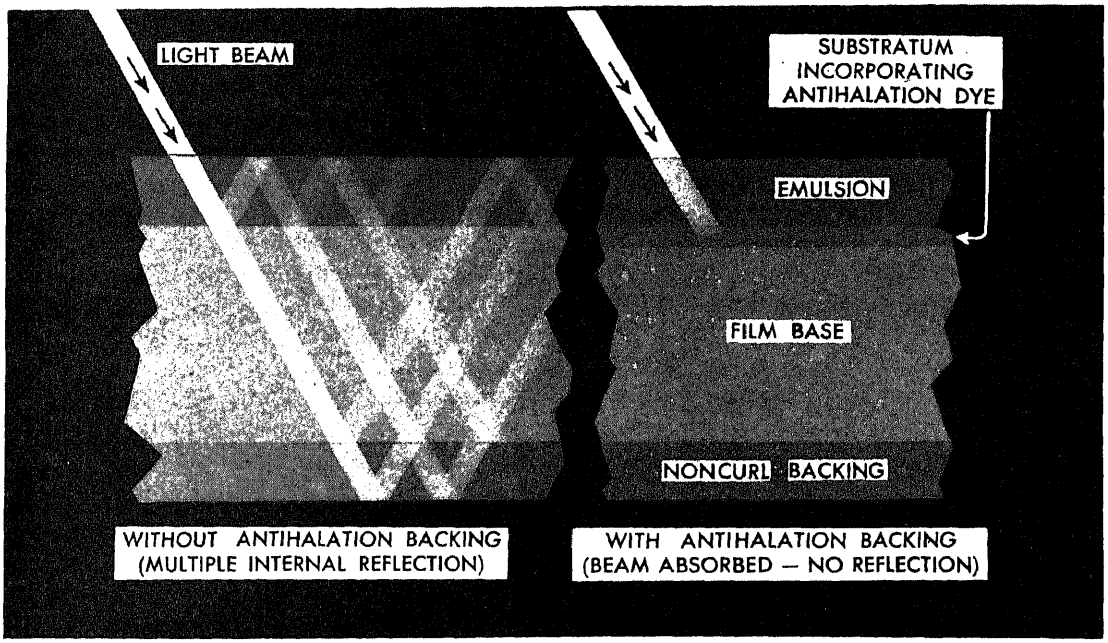
Some paper negatives have a white, semi-opaque base, which requires considerably longer exposure when the plate is produced. The translucent negatives can be exposed for approximately the same length of time as film when the plate is produced.

Paper negatives are not recommended for halftone work because of the paper grain. This grain may cause a mottled effect when the halftone is exposed on the plate.

FILM

Photomechanical film consists of a base coated with a light-sensitive emulsion on one side and a gelatin noncurl backing on the other side to prevent the film from curling as it dries. The base is commonly cellulose triacetate, called an acetate base. It is satisfactory for most uses. Some manufacturers produce a light plastic-base film that is adequate for line work requiring minimal stability. Plastic-base films are used much the same as paper negatives. The polystyrene- and polyester-base films are used where dimensional stability is required.

The manufacturer generally places a layer of dye between the emulsion and the film base to prevent internal reflection. This dye, known as the antihalation backing, absorbs the light after it passes through the emulsion and prevents the light from striking the base and reflecting back


LIGHT BEAM
SUBSTRATUM INCORPORATING ANTIHALATION DYE
EMULSION
FILM BASE
NONCURL BACKING
WITHOUT ANTIHALATION BACKING (MULTIPLE INTERNAL REFLECTION)
WITH ANTIHALATION BACKING (BEAM ABSORBED — NO REFLECTION)

57.103

Figure 6-6.—Halation through film.

to other areas of the emulsion, as shown in figure 6-6. This dye dissolves during processing (developing) operations after the film is exposed.

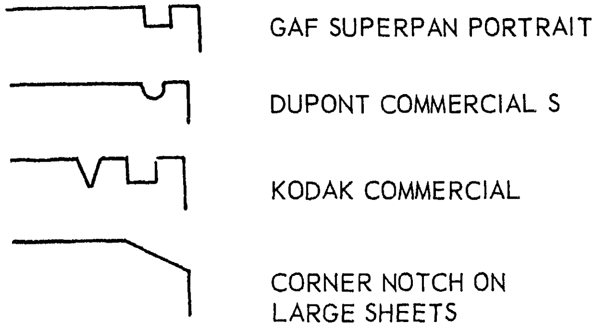
Film thicknesses range from .003 inch (thin base) through .005 inch (regular base) to .007 inch and .015 inch (thick base). Regular base film is generally used for most of your work; thin base may be used for special contact situations; and thick base film may be used if additional stability is required. A special kind of film, stripping film, is used in some shops for combination and close-contact work. After a few minutes in warm water, the emulsion soaks loose from the stripping film backing, and the emulsion can be stripped onto another backing in combination with other negatives.

Although film is available in rolls, most shops use precut sheet film. Most sheet film is notched in one corner. The notch shows the type of film and helps you to determine the emulsion side when you are in the darkroom. When you hold the film with the notch at the top and right, the emulsion will be facing you. Some large sheets simply have the entire corner cut, as shown in figure 6-7. Some blue-sensitive and orthochromatic films are not notched because you can determine the emulsion side readily by looking at the film in safelight. Under safelights, the emulsion side of a sheet of these films appears dull compared to the non-emulsion side.

> NOTE
>
> As you have seen, the preparation of photographic emulsions is the result of a number of variables. These variable factors are rigidly controlled by the manufacturer to produce a wide range of emulsion characteristics, such as color sensitivity, contrast, and speed.

When the human eye views an object, it receives two distinct sensations—difference in brightness and difference in color. Film used in black-and-white photography registers only differences in brightness. Color differences are translated into brightness differences. The ability to translate colors into shades of gray on the film is known as the color sensitivity of the emulsion.

The normal sensitivity of photographic emulsions is limited to the blue region (blue, blue-violet, and ultraviolet) of the spectrum. Such emulsions are known as regular, blue-sensitive, or color-blind film. They are insensitive to the



57.104

Figure 6-7.—Sheet film reference notches. The notches are different on each type of film.

green and red portions of the spectrum. These films register blues as dark grays on the negative and light grays on the print; all other colors register as light grays on the negative. Color-blind films are used for black-and-white copying only, or for making contact positives from other negatives.

By adding certain sensitizing dyes to the emulsion, the normal sensitivity may be extended to other regions of the spectrum. One type of dye will render the emulsion sensitive to the green and yellow regions as well as the blue. This emulsion is known as *orthochromatic*, meaning straight color, which refers to this emulsion's ability to give a truer rendition of color. Orthochromatic, or ortho, films are used for single-color subjects, or for objects that do not require red rendition.

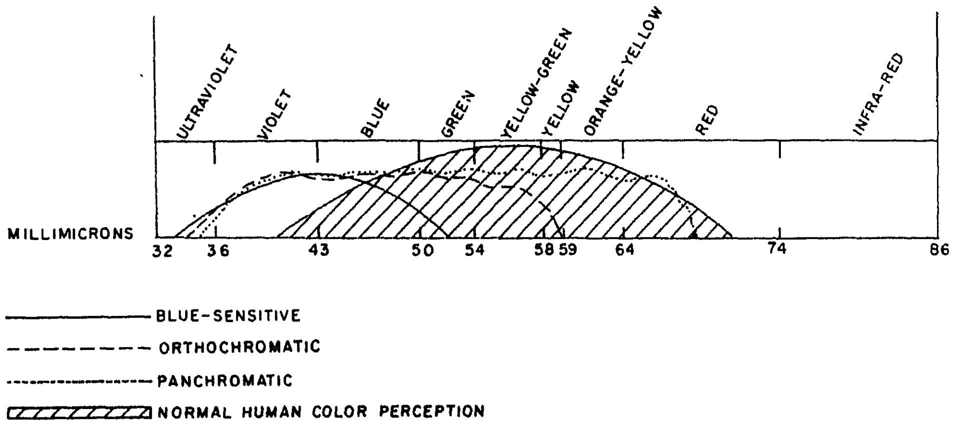
Other dyes can be added to extend the range of sensitivity into the orange and red regions of the spectrum. Such films are known as *panchromatic*. Panchromatic film emulsions are sensitive to all colors and are used when all colors are to be reproduced.

The diagram in figure 6-8 shows the relative color sensitivity of blue-sensitive, orthochromatic, and panchromatic emulsions as compared with the sensitivity of the normal human eye color perception.

Color sensitivity also depends on the light source used in exposing the film. Tungsten lamps give off a greater percentage of red light. For this reason, exposures to the camera tungsten lamps are longer when ortho films are used. Quartz-iodine lamps have color characteristics similar to tungsten lamps. Pulsed xenon lamps give off a high percentage of blue light but have some excess red/infrared radiation.

The blackness (density) of the silver deposits on the film, after processing, directly affect the amount of light that can pass through it. Naturally, more light is transmitted through the gray areas than through the blacker, denser areas of the negative. The difference in densities of the various areas of the negative is called contrast. Normal contrast is represented by a full range of densities from dense blacks, through intermediate grays, to transparent, open areas. High-contrast negatives do not have a full range of densities; they consist of dense blacks and transparent areas only. Low-contrast negatives have very little difference in densities; everything is rendered as a medium gray.

Films used in regular photography (snapshots, for instance) are generally normal contrast films; and, because they can record a wide range of



tones, they are also known as long-scale films. The high-contrast films, such as those used in lithography, are known as short-scale films, because they record only a very narrow range of tones.

KINDS OF FILM

There are many kinds of film. But as a Navy Lithographer, you will be concerned only with those film used for copying and reproduction purposes. Most of the time you will be working with photomechanical (process) film, although you may have some occasion to work with continuous-tone films. Both types are similar in general composition and properties. However, they vary primarily in contrast, and also in relative sensitivity and grain size.

Continuous-tone (commercial) films are used for general photography, such as the snapshots you might take with your personal camera. These films are used because they have a wide range of tonal values. Process films are used chiefly for line and halftone work. Because they are so contrasty, they form sharp, abrupt breaks between light and dark areas, and intermediate gray areas either register as black or drop out (are lost) entirely. For this reason, they are not suitable for continuous-tone work.

Take a look at the top illustration in figure 6-9. It was shot with process film. Notice how clear the lettering appears; yet the photo is a mere black-and-white skeleton. All the light gray details have been lost, and the dark grays have merged with the black. This merging results in the loss of important details in both highlight and shadow areas.

Now look at the bottom illustration, which was made with a continuous-tone film. This film has a long scale and reproduces more faithfully the actual tones of the original. Notice that the details of the photograph are reproduced in various shades of gray, much as the original. However, the lettering has lost the contrast that was present in the photograph above.

From this last illustration, you might draw the conclusion that lettering or line work should be copied with process film and that all tone work should be copied with continuous-tone film. This is true if regular photographic prints are to be made from the negatives, but a different procedure must be followed if the job is to be printed on the lithographic offset press.

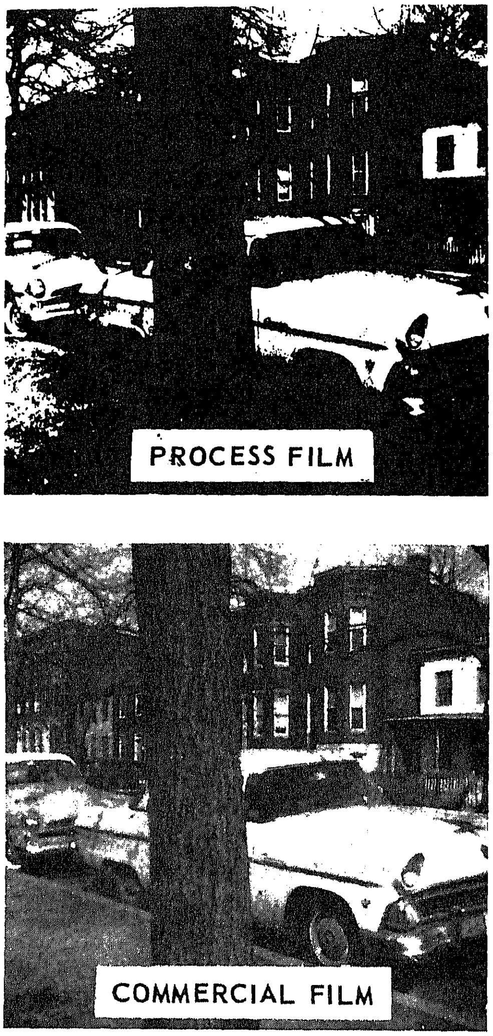


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Figure 6-9.—Comparison of camera shots with process film and continuous-tone (commercial) film.

The offset press transfers a solid layer of ink to the paper; it can produce only solid blacks and whites. It is the image on the plate that determines whether an area will print light or dark. To reproduce the subtle gray tones in photographs or other continuous-tone copy (such as a sketch in pastel chalks), the camera operator must shoot the copy through a halftone screen. The screen breaks up the image into a series of small dots of various sizes. Strong light reflections from the light areas (highlights) of the copy pass through the openings in the screen and fan out to produce large black dots on the negative. Weaker reflections from the dark areas (shadows) or gray areas (middletones) form smaller dots. When the film is developed, the image is formed by a series of dots, which vary in size according to the brightness reflected from the original copy. When the plate is made from this negative and run on the press, the dots print as tiny black solids. Since the dots are so small, they blend together to give the impression of a continuous tone. Areas where the dots are large look darker than areas where the dots are small with more white space between them, because the eye mixes the white space with the black dots and subdues the color. This gives the impression of a gray tone. Thus, the varying sizes of the dots produce graduated tones like those found in the original.

Process film is used for both line and halftone negatives, because high contrast is required to produce printing images that have sharply defined printing areas. Figure 6-10 shows a comparison of prints made with continuous-tone, line, and halftone negatives.

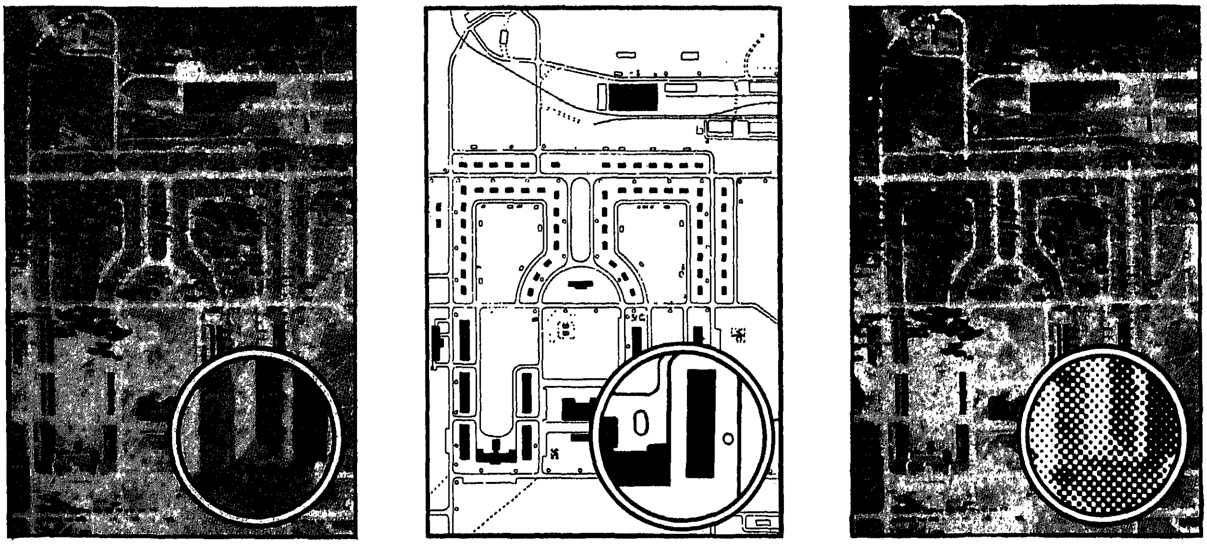
Each type of film has its own particular purpose and works at its best only when used for the purpose intended. In an emergency, you may substitute one type of film for another, but, if this is done, you must make compensations during processing. For example, if you use a continuous-tone film for line or halftone work, you must develop it to the fullest. On the other hand, if you use process film for continuous-tone work, you must dilute your developer (generally 4 to 6 parts of water to 1 part of developer) to soften the development.

Most film manufacturers include a film information sheet in each box of film. This information sheet provides data on recommended exposures, processing instructions, and other pertinent facts regarding the characteristics of that particular film. Information on photographic materials can be found in the *Photo-Lab-Index.* This reference manual is published by Morgan & Morgan, Inc. of New York. It is recognized as the bible of photographic information, because it provides valuable information on the many problems that may exist or occur in photolithographic work. You should be able to get a copy of this manual from your command's photo lab.

SPEED

The speed (sensitivity to light) of an emulsion is an indication of the amount of light required to produce a satisfactory negative. You have already seen that the more sensitive (faster) film is more grainy than the less sensitive (slower) film. Most process film is slow and very contrasty. The grain of this film must be very fine to reproduce thin lines of the copy and fine halftone dots with sharpness. The ability of the film to reproduce thin lines is known as its resolving power, and it is expressed in lines per millimeter. Since there is ordinarily no movement during copying, the speed of the film is of relatively little importance.

Some emulsions are fast and others are slow, so it is necessary to have some system that shows



CONTINUOUS – TONE

LINE

HALFTONE

57.107

Figure 6-10.—Comparison of prints from continuous-tone, line, and halftone negatives.

how the speed of one film compares with that of another. The International Standards Organization (ISO), a federation of all national standards, has established a method of measuring and expressing emulsion speeds.

The emulsion speed expression is known as the ISO or the ISO speed. Since this method is recognized by film manufacturers, the ISO sets the standards that rate the sensitivity of black and white and color film. The ISO designation will generally look like this:

ISO 100/21°

The number immediately after ISO is the American National Standards Institute's (ASA equivalent value) rating of the films relative sensitivity to light. The number with the degree symbol (°) is the German standard (DIN equivalent).

Film speed is important since it is related to the amount of exposure required to produce usable images on the film. Emulsions are rated as slow or fast depending on the amount of light needed to yield the required image. Process films have relatively slow emulsion speed ISO number values.

The ISO numerical value assigned to the film is used with exposure meters, guides, and other devices to assist in computing exposure times. Information on ISO numbers is included in each box of film.

TYPES OF EXPOSURES

You have already seen that the color sensitivity is affected by the type of lighting used. Such differences in color sensitivity also affect exposure time. Daylight contains a large quantity of blue light, while tungsten light is predominantly red. For this reason, it is necessary to assign two different exposure situations—one for daylight and one for tungsten. All films have a higher index for daylight than for tungsten because of

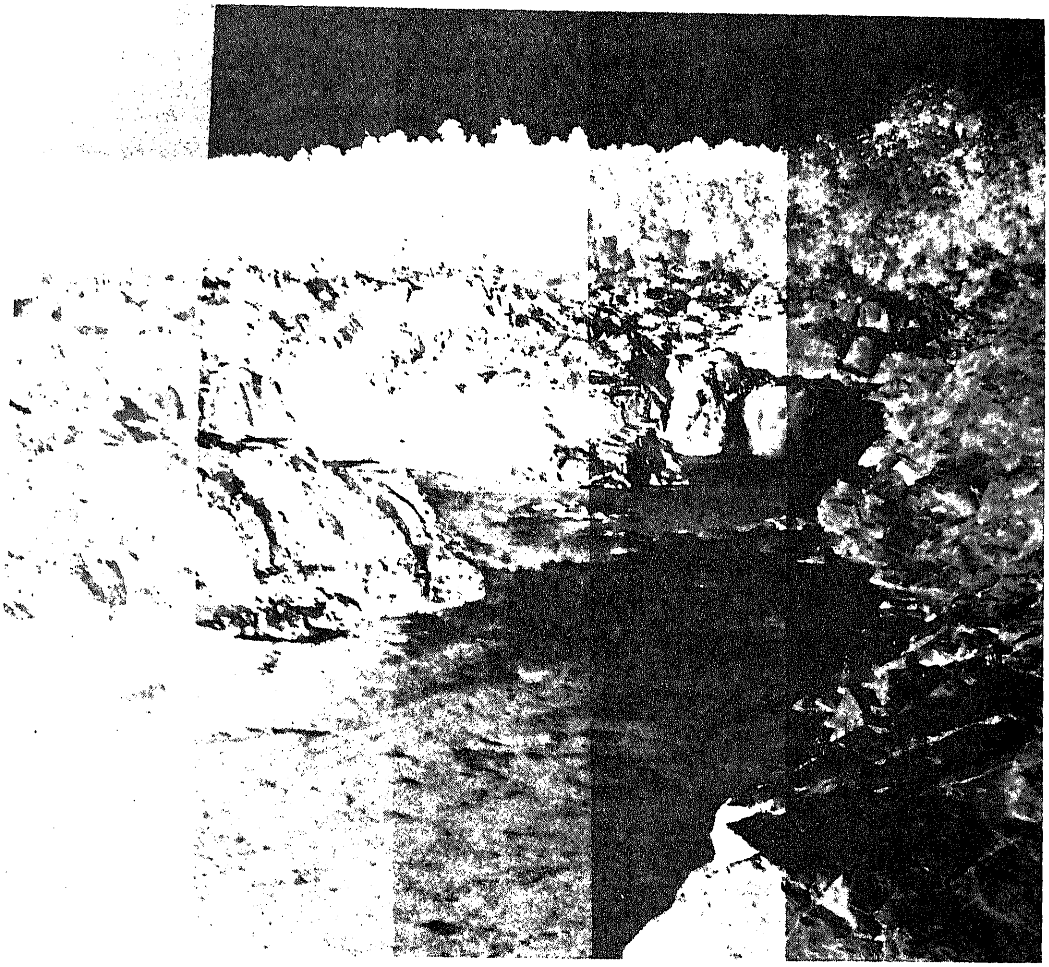


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Figure 6-11.—Results of six separate exposures on the same negative.

the smaller percentage of blue-violet color in the artificial light. The difference in exposure is less for panchromatic film, because it is sensitive to all colors and can utilize the yellow and red radiation that form the greater portion of most artificial light.

Many shops prepare a table showing approximate exposure times for each type of film used in their particular setup. The table generally takes into consideration different types of copy and percentages of reduction and enlargement required. You may use the table for the average work. For different films or with out-of-the-ordinary work, you should determine your exposures with a series of test exposures.

You can make a series of test exposures on a strip of film. An example of a test exposure negative is shown in figure 6-11. To do this, use black paper to mask off the copy so that one area at a time will be exposed, or, if you have access to the camera back, you can mask off the film with black paper. As an example, you can expose the first area for 6 seconds; then expose the second area for 8 seconds. Expose the other areas for 11, 15, 20, and 27 seconds, or at some other convenient intervals. After processing according to the manufacturer's instructions, examination of the film will show you the proper exposure.

CHARACTERISTIC CURVES

Film manufacturers make a series of exposures on a particular film and then measure the densities of the developed strips. The measured densities are then plotted on a graph against the logarithms of the measured exposure times used in producing the densities. By plotting the densities against the log exposure times, they come up with a curve similar to the one shown in figure 6-12. This curve

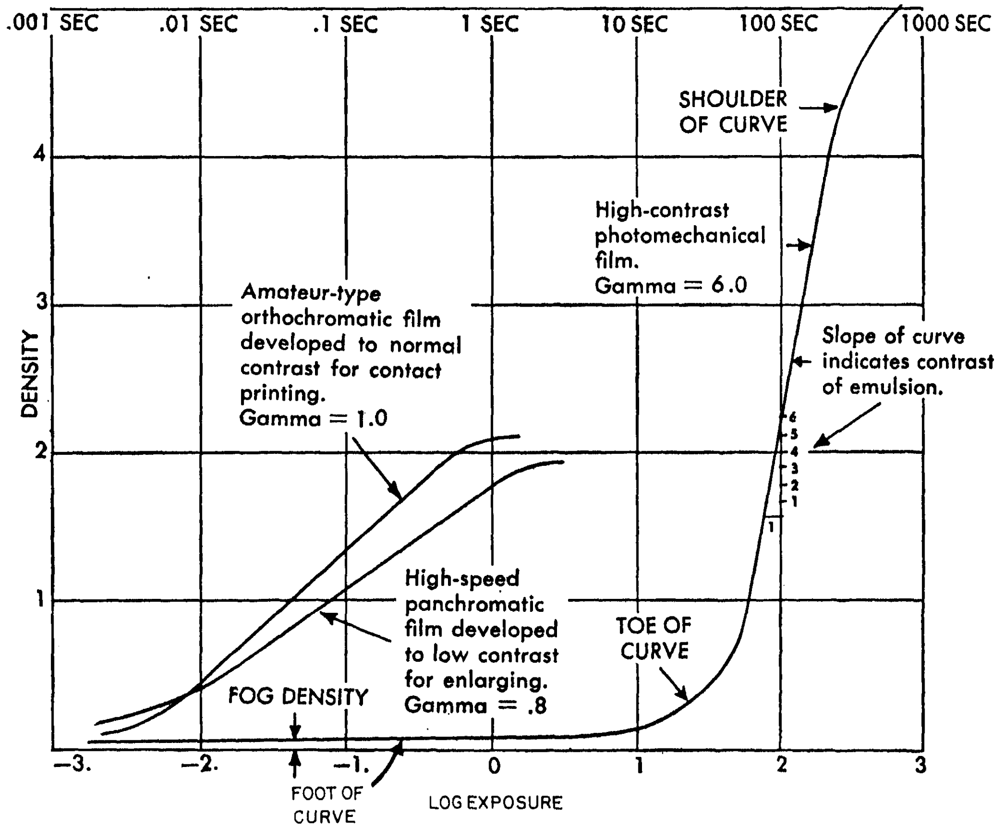

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Figure 6-12.—Characteristic curves for negative emulsions made by plotting negative density against log exposure time. The characteristic curve for photomechanical film has a very steep slope because process films are very contrasty. Continuous-tone films are less contrasty and the slope of their characteristic curves are not as steep. It is necessary to use logarithms of exposure times because the densities are actually a logarithm (to the base of 10) of the opacity of the negative. This means that density 1 represents an opacity 10 times greater than density 0. Similarly, a log exposure of 1 represents 10 seconds; log exposure 2 represents 100 seconds, and so on. Log exposure −1 represents 1/10th second; log exposure −2 represents 1/100th second, and so on.

is known as the characteristic curve, because it shows the properties peculiar to that emulsion.

The foot of the curve represents the shadow areas of the negative, the shoulder represents the highlight areas, and the straight-line portion represents the gray, middletone areas. The slope of the straight-line portion shows the degree of contrast it is possible to attain in developing the film. This slope can be measured by a mathematical formula and assigned a numerical value, known as gamma (the Greek letter γ). If this slope is at a 45-degree angle, for example, the increase in density is directly proportional to the increase in exposure, and the contrast of the negative is the same as that of the original. If the slope is steeper, the contrast of the film is greater. Most process films can be developed to a high contrast (gamma 3.0 to 10.0, indicating that the contrast is 3 to 10 times that of the original). Continuous-tone films, on the other hand, may develop to approximately the same contrast as the original (gamma 1.0). The gamma, or developing contrast, builds as long as the film is left in the developer, until a point is reached where it levels off. Later in this chapter, you will learn how to develop negatives to a desired contrast by the use of time-temperature development charts.

PROCESSING THE FILM

As you have already seen, when the sensitized emulsion is exposed to light, the light acts on the silver halide particles to form an image. This image is invisible, and it is called a latent image. The latent image can be converted to a visible image by the action of certain chemicals. This process is called developing or processing.

When the exposed film is placed in the developer, the unexposed silver halide particles are not changed, but the exposed particles are chemically reduced (oxidized) to form black metallic silver. This produces a visible image on the film.

Following development, the film is washed and then transferred to the fixing solution, which removes the unexposed silver halides to prevent further exposure by light.

DEVELOPER

Developing solutions are composed of a number of chemical agents. Each agent plays an important role in the reduction of the exposed silver halides into metallic silver. When the film is placed in the developer, the developer penetrates into the emulsion and starts the reduction. As development continues, the metallic silver becomes darker, and contrast increases. If the development continues too long, the unexposed silver halides may become oxidized and darken (turn gray or fog). Different films require different developers, and different developers require different developing times to produce satisfactory negatives.

The developing agent, or *reducer*, is the most active ingredient in the developer. Many chemicals could be used as developing agents, but most reducers are so powerful they would reduce all the silver halides in the emulsion, exposed and unexposed. A suitable reducer affects only the exposed particles of silver halide. A reducer is chosen for its ability to convert the silver halide in the emulsion into metallic silver in proportion to the amount of light reaching the emulsion. The two most commonly used reducers are hydroquinone and p-methylaminophenol sulfate.

Most developing agents are neutral or slightly acidic when in solution. Since they do not work effectively in this condition, alkalies are added to speed up the development of the negative. The alkalies also swell the gelatin to permit rapid penetration of the reducer into the emulsion. Such chemicals as sodium carbonate, potassium hydroxide, and borax are used as *accelerations.* Sodium hydroxide and paraformaldehyde are frequently used accelerators in photomechanical (process) developers.

Some developers, especially those containing paraformaldehyde, require an ingredient to control the alkalinity of the solution. The most commonly used ingredient, called a *buffer,* is boric acid. The buffer also helps to keep the developer clear by reducing the precipitation of substances that cloud the developing solution.

When in an alkaline solution, the reducers also react readily with the oxygen in the air, causing a deterioration of the developer. To lengthen the life of the developer (retard deterioration), a *preservative* is added to slow the rate of oxidation. The preservative absorbs excess oxygen from the water and the surrounding air. Sodium sulfite is the most widely used preservative. In photomechanical developers, sodium bisulfite and potassium metabisulfite are frequently used. Since the preservative also increases development time, you should only add enough preservative to provide a *satisfactory* working life to the developer.

A final ingredient in the developer is the *restrainer*, which retards the speed of development and inhibits fogging of the negative. The usual restrainer used is potassium bromide. Excess restrainer will cause slow development; too little restrainer will permit overdevelopment and the clear areas of the negative will fog.

With use, the activity of some of the ingredients of the developer will gradually decrease. The useful life of a developer is usually determined by the manufacturer and is published on the information sheet found in the film box. The developer's useful life is affected by the amount and type of film developed, the ratio of exposed to unexposed film area, and the age of the developing solution. It is standard practice to replace the developer before its useful life is exhausted.

Preparing the Developer

Manufacturers of processing solutions for the graphic arts industry have made the mixing and preparation of solutions a simple process. The major chemical manufacturers produce the stock solutions for photomechanical developers in concentrate form. These concentrates are prepared for use in the darkroom by simply diluting them with water.

The developers you use for processing films are separated into two parts or stock solutions. These stock solutions are referred to as part A and part B. Since stock solution must be mixed with water before you can use it, distilled water is best to use. However, tap water is usually suitable. Aboard ship, your best possible source of distilled water is the ship's evaporators. Instructions for mixing stock solutions (part A and part B) can be found either packaged with or printed on their individual containers. You should follow these instructions as you are mixing each part of the stock solution. After you have mixed one part (part A or B), mix the other part, and then combine both parts in the developing tray.

NOTE

Parts A and B should not be mixed together at full strength because this will cause rapid deterioration of the developer.

Since film manufacturers prepare their emulsions with a specific developer in mind, you should try to use the developer recommended by the film manufacturer.

Temperature

Temperature is a very important factor when you are processing photographic materials. You should not only consider the temperature at which the chemicals and solutions must be maintained, but also the temperature of the area where they are being used. Therefore, to maintain constant temperature, air conditioning is necessary in the processing area. The most satisfactory negatives are produced when the temperature of all processing solutions is kept at 68°F. This is the standard temperature of the photographic industry.

At temperatures below 50°F, development stops entirely. On the other hand, high temperatures cause the developer to become overactive. As temperatures increase, overdevelopment, fogging, and fill-in may result. When temperatures are high and you must process negatives, reduce the development time or dilute the developer. High temperatures also shorten the useful life of the developer.

At temperatures above 75°F, the photographic emulsion becomes excessively softened. Reticulation (breaking up of the emulsion) and frilling (separation of the emulsion from the base along the edges) may then occur. Reticulation, frilling, and blistering (bubbles forming between the emulsion and the base) may also occur when temperatures of successive processing solutions vary to extremes.

As you have seen in chapter 5, temperature-controlled sinks are ideal for maintaining constant temperatures for processing solutions. If they are not available, you may be able to control the temperature by placing the trays containing processing solutions in a larger tray containing ice water or hot water, as required. Never put ice directly in the solutions, as the ice will melt and dilute them. When ice is not available, you can use cold tap water in the larger tray, or start the processing in the early morning before temperatures start to rise.

At higher temperatures, the use of a prehardener before development will sufficiently harden the emulsion so that processing may be done at temperatures up to 110°F. The formula to use for prehardeners is found in the *Photo-Lab-Index* publication.

Developing Time

Because of the actinic action of light, the exposed portions of the film can be developed with less expenditure of chemical energy than the unexposed portions. Therefore, the exposed portions develop readily—long before the chemicals start to reduce the unexposed silver halides. If the development is carried on too long, however, the developer will start to act on the unexposed portions and cause the unexposed areas to turn gray (fog).

Process films are generally developed from 2 to 5 minutes, depending on the strength of the developer, its temperature, and the degree of contrast (gamma) desired in the negative. You can use a time-temperature chart, such as those shown in figure 6-13, to determine how long the film should be developed at a given temperature to produce a given contrast. A time-temperature chart is usually included with each package of film, or you may find it in the *Photo-Lab-Index.* If you have full control of the developing temperature (a properly operating temperature-controlled sink), the time-temperature method is the most consistent method of film processing. This method allows you to control contrast variation without having to manipulate lens aperture, exposure time, or illumination.

Developing solutions will deteriorate upon exposure to air. Some film developers will decompose in a few hours. Whenever possible, schedule your work in the darkroom so that all the film processing will be completed within a reasonable length of time. If it is necessary to process film several hours after the solutions have been mixed, you may revive the developer by adding a small amount of fresh developer solution. To add fresh developer solution in this manner is termed replenishment.

Developers should not be used indefinitely. They should be replaced when they have decomposed to the extent where processing takes twice as long as normal.

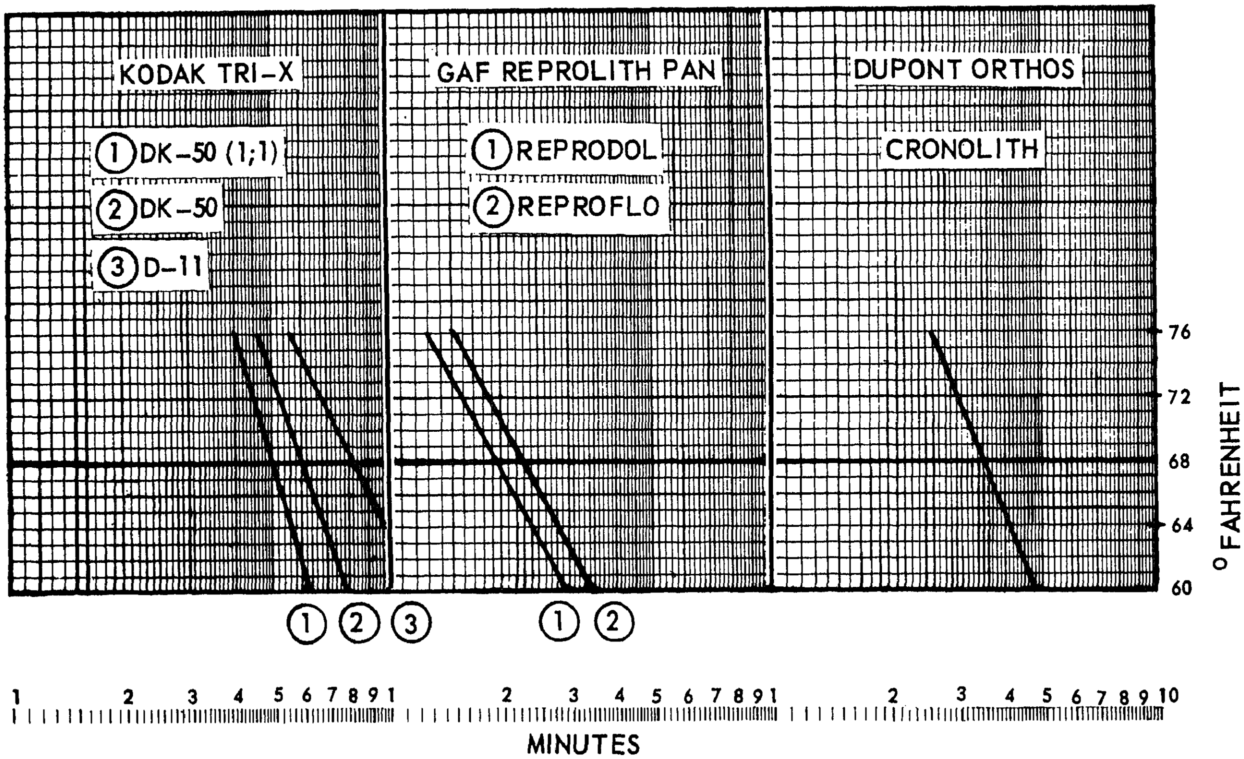

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Figure 6-13.—Time-temperature development charts. Numbers along the side represent the temperature of the developer and those at the bottom indicate development time in minutes. The diagonal lines represent recommended contrast or gamma. The heavy horizontal line indicates the normal developer temperature of 68 °F. As you can see, as the temperature increases, time of development decreases. When more than one developer is recommended for a particular film, the chart shows a separate diagonal line for each developer.

Development by Inspection

Under conditions where the temperature cannot be fully controlled, you may develop film by inspecting it instead of using a set time method. This inspection should be done by viewing the film n front of a safelight frequently until the image starts to form, and at 5- to 10-second intervals thereafter. Total development time should be about four times that required for the image to first appear. For example, if the image begins to appear at 45 seconds, total development time should take about 3 minutes. When you are creating a special or unique effect in your negative, you should use the inspection method so you can see the negative go through each step as it is developing. Then stop development when your desired effect is reached on the negative.

Agitation of the Developer

Under normal conditions, the temperature of the developer at the top of the tray is higher than that at the bottom of the tray. You should agitate the solution by rocking the tray to equalize the temperature before the film is placed in the developer. It is also necessary to agitate the solution while the film is being developed. This removes the spent developer and developing by-products from the emulsion, and it brings a fresh supply of developing solution to the emulsion. Most process films are developed with intermittent agitation. This requires constant motion of the film in the developer for the first 15 seconds and at 10-second intervals thereafter. You can do this by moving the film or by gently rocking the tray. Lack of agitation may cause film streaks. However, when using certain films, or when shooting extremely fine lines, you should process the film without agitation. This is known as still development.

SHORT-STOP BATH

The term *short-stop bath* is used to describe this solution, because it instantly stops development by neutralizing the alkaline developer on the negative and prevents contamination of the fixer by the developer. Transferring the film directly from the developer to the fixer may cause blistering of the emulsion. This direct transfer shortens the life of the fixing solution, since the alkali in the developer neutralizes the acid in the fixing solution. For this reason, negatives are generally washed in plain water for 20 to 30 seconds after they are taken from the developer. This removes most of the developer that the negative would otherwise carry over to the fixer. However, when using plain water as a short-stop bath, you must remember that development of the film could continue slightly. Instead of plain water, you may use a diluted solution of acetic acid and water between the developer and the fixer.

At this point of processing, if the temperature is extremely high, you can place the film in a hardening solution. Rinse the negative and place it in the hardening bath for a few minutes before fixing.

FIXING SOLUTION

The fixer dissolves all of the undeveloped silver halides in the emulsion and clears the film to prevent further action by light (exposure). The fixing solution is generally referred to as hypo, because the principal ingredient, sodium thiosulfate, is also known as hyposulfite of soda or hypo.

Acetic acid, or another acid, is also used in the fixer to neutralize all the remaining alkaline developer carried over on the film. Sodium sulfite is included in this fixing solution to prevent the hypo from being decomposed by the acid. Also, a hardening agent, such as potassium alum, is added to the fixing solution to toughen, or tan, the gelatin of the film negative.

The fixer should be agitated frequently until the white, milky portions of the film emulsion have cleared, and occasionally thereafter during the remainder of the fixing time. The length of fixing time is generally double that required to clear the unexposed portions of the film, and the time varies from 1 to 5 minutes, depending on the type of film and the solutions used. When the negative has cleared in the fixer, the film is no longer light sensitive and may be freely inspected.

The life of the fixer is controlled by its ingredients, the conditions under which it is used, and the amount of developer carried over to the fixer on the film. The fixer should be discarded when it takes twice the normal time to fix the negative.

If you need the negative in a hurry, you can take it from the fixer as soon as it clears. The negative can be used without proper fixing, but you must return it to the fixing bath for complete fixing. After fixing is completed, wash the negative thoroughly if it is to be saved for future use.

WASHING

If the film is to be saved, it should also be washed from 10 to 20 minutes (depending on the temperature of the water) in an ample supply of fresh running water after fixing. If the chemicals left by the fixing bath are not removed from the emulsion, they will cause brown stains and destroy the image by oxidation. Photographic paper and paper negatives should be washed 30 to 40 minutes since they are more porous and the chemicals are more difficult to remove. If the negative is not to be saved, a 1- or 2-minute wash is sufficient before drying and using the negative.

You may find that your ship is faced with the problem of excessive water consumption. Operational requirements may demand that you produce vast amounts of printed matter requiring camera work, and the ship may not be able to furnish the large amounts of fresh water required for prolonged photoprocessing. In such cases, it will be necessary to use seawater (salt water) for washing negatives or paper prints. You should wash the materials for half the time recommended in seawater, then wash them another 5 minutes in fresh water. Some camera operators use chemical hypo-removing chemicals in the wash when water is in short supply or if they are in a hurry for the negatives. These chemicals reduce the time required for washing.

As you know, temperatures above 75 °F may cause reticulation, frilling, or blistering. The same problems may result if there is great temperature variation between the successive processing solutions. These solutions should be kept at the same temperature during all stages of processing. This is still another reason for the importance of processing in an air-conditioned environment.

DRYING

After washing the film, you may go over it with a soft sponge or squeegee to remove excess water before drying. You may treat all your negatives with a wetting agent, such as Kodak Photo-Flo, to prevent water spots. You can hang the film to dry in a warm, dry room or in a drying cabinet; or you may dry it in a commercial film dryer. Of course, you should use only the required amount of heat, because excessive heat can blister the film.

REDUCING

You have already read that film may fog if developed too long. Fog may also occur if the film is out of date (old) or if it has been stored improperly, or if there are internal reflections in the lens or a leak in the camera bellows. The presence of fog makes a negative not usable, since it is difficult to estimate the exact density of the fog and its influence on platemaking. Process negatives require dense black solids and clear, transparent open spaces. If thin lines fog or fill in, you will generally find it quicker and more efficient to make a new negative. However, in an emergency, you can dissolve the unwanted developed silver grains in the image areas with a chemical solution known as a reducer. Of course, when you dissolve the silver in the image areas, you will also dissolve some of the silver in the opaque areas. However, the opaque areas are generally so dense that a small amount of reduction will not appreciably alter their density value.

A solution of potassium ferricyanide and sodium thiosulfate (hypo), known as Farmer's Reducer, is commonly used for the density reduction of films and plates. The potassium ferricyanide unites with the silver on the negative to form silver ferricyanide, which, in turn, is dissolved by the hypo.

The negative may be placed in a tray of the reducing solution, or you may apply the solution with a cotton swab when reducing just local areas of the negative. The speed of the reducer depends on its concentration and the quantity of potassium ferricyanide in the solution. During reduction, you should frequently view your product to check progress. The formula given in appendix II of this manual is adequate for normal use.

To stop the action of the reducer on a negative, you must be prepared to immediately apply your standard darkroom hypo solution (never use an acid-fixer hypo solution) to the negative or on an area of the negative being reduced. When the hypo solution contacts the reducing solution on the negative, the reducing solution is diluted and the reducing action slows down or stops completely. Whether the reducing action slows down or stops completely depends on the amount of hypo you apply to the negative and the hypo strength.

INTENSIFICATION

Intensification is just the opposite of reduction. Intensifiers increase the density of silver grains in the emulsion by adding compounds of eavier metals, such as chromium or mercury. Solutions of potassium bromide and mercury hloride and sodium cyanide and silver nitrate known as Monckhoven intensifier) are generally sed to intensify process negatives. This intensifier oes not fog the film and tends to clear the ransparent areas while adding density to the black reas of the negative.

To intensify the negative, you should first leach the image with the potassium bromide/ ercuric chloride solution. Then wash the egative and blacken it with the sodium cyanide/ ilver nitrate solution. You should use great care hen working with cyanide solutions.

CAUTION

Cyanides are *extremely poisonous*. When cyanides contact acids, they produce deadly hydrogen cyanide fumes. You should always use adequate ventilation. Never use acid-fixer solution as a substitute for the hypo solution in the formula.

Intensification isn't quite as practical as it ounds. Process negatives are seldom intensified, ecause it is quicker to make a new negative. hen, too, intensification is effective only when he negative is underdeveloped; underexposed egatives are almost unaffected. However, it may e necessary to use intensifiers if there is a film hortage.

PHOTOGRAPHIC PAPERS

Six grades of photographic papers are used for aking contact prints. The emulsions are almost ntirely silver chloride, and contact papers are ften referred to as chloride papers.

Hard (contrasty) paper is required if the egative is thin and flat; medium grades of paper re used for normal negatives; and soft papers are sed for contrasty negatives. Papers are generally raded by number—No. 0 being the softest and o. 5 the hardest or more contrasty.

Enlarging paper emulsions, which are primarily silver bromide, are faster than contact aper. These enlarging papers are available in five rades of contrast. The hardest paper, No. 5, is sed for extremely flat, thin negatives; medium contrast, No. 3, for normal negatives; and the softest, No. 1, for contrasty negatives.

Variable contrast enlarging papers are also available. These papers are coated with an emulsion whose contrast depends on the color of the light source used during the exposure. For example, if variable contrast enlarging paper is exposed with blue light, it renders a very hard or contrasty image; and if it is exposed with green light, the same paper produces a very soft image. Therefore, it is possible, by using a series of colored filters, to duplicate on one grade of paper a range of contrasts that normally would required several different grades of enlarging paper.

When you are making photographic prints, do not try to control contrast by manipulating development time. It is always better to select the proper photographic paper according to the type of negative and to control the contrast by varying the exposure.

Photographic prints are processed much the same as photographic film. As with film, you will achieve better results if you use the developer recommended by the manufacturer of the paper. Instructions for mixing and developing are printed on or included with each package of developer. Kodak D-72 (Dektol) is often used for photographic prints as well as for continuous-tone film. The formula can be found in appendix II.

DUPLICATING AND AUTOPOSITIVE FILMS

The majority of your work in the darkroom requires that you use the standard photomechanical process films. The photographic image produced on standard films is the opposite of the original (or reversed). A black-on-white image (positive) produces a white-on-black image (negative).

There are other types of films that have applications in the Lithographers' darkroom. Duplicating film and autopositive film are two of these. With duplicating film, you can obtain a negative directly from a negative or a positive from a positive. The same is true of autopositive film; however, with autopositive film, you also have the capability to produce a combination (negative and positive) image on the same piece of film.

Duplicating film must be handled in the darkroom under either light red or yellow safelights. Processing of duplicating film is similar to processing of other photomechanical films.

Autopositive films are handled in ordinary light. Exposure to white light increases the density of autopositive film. To remove density, that is, to clear the film, a yellow light exposure is made. Autopositive film is processed in the same manner as other photomechanical films.

For detailed instructions and applications of autopositive and duplicating films, you should read and study the various guides and data sheets available from film manufacturers.

SAFETY PRECAUTIONS

Many of the chemicals used in photographic work are skin irritants and others may caused serious injuries or even death if handled improperly. Although not all photographic chemicals are poisonous, they should be treated as such and handled with caution.

Both strong acids and alkalies will cause severe skin burns. If an acid comes in contact with your skin, wash it immediately with plenty of water, then neutralize the acid with bicarbonate of soda (baking soda) or some other weak alkali. Report to sickbay. Alkalies should also be washed off in water, then neutralized with a weak acid, such as well-diluted acetic acid (vinegar). The acid should, in turn, be washed off with plenty of water.

NOTE

Be sure to report to the medical officer any skin eruptions or irritations as soon as they appear.

Some chemicals release poisonous vapors and should be handled only in rooms with adequate ventilation. Carbon tetrachloride is extremely toxic, and its use is prohibited aboard ship. Benzol, formaldehyde, wood alcohol, ammonium hydroxide, and leaded gasoline are also toxic. Nitric acid in contact with wood or other organic materials releases deadly vapors. Fumes released when cyanides contact acids are extremely dangerous.

Some chemicals corrode the trays, tanks, or sinks in which trays are stored or handled. All containers used to hold the solutions should be rinsed out carefully with water when they are emptied. Acids or alkalies should be stored in recommended receptacles only. *Never* add water to acids. *Always* add acids to water gradually.

Before disposing of any chemicals or chemical solutions, you should check with the engineering or public works personnel at your command or activity to ensure that you are complying with the Navy's latest antipollution regulations. It may be necessary to make special provisions for your shop's chemical waste disposal because of the reactions that occur on some pipe fittings and gaskets in certain types of waste disposal systems or plumbing. Never pour just any chemical or chemical solution down a drain.

Be suspicious of large batches of film that seem to have been exposed. This could be due to radiation. X rays used by yard workers or ship's force to check welds, and so on, are particularly destructive to emulsions. You should make it your business to know where and when X rays will be used during your yard period. Also, you should know whenever work of this nature is being done in and around your areas.

Although today's lithographers work mainly with commercially mixed chemicals and do not have to deal with bulk chemicals, the danger of personal injury from chemicals is still there and a knowledge of the do's and don'ts is a must for safety. The following safety practices must always be observed.

DO'S

- Do maintain scrupulous housekeeping practices in all areas where chemicals are used.
- Do wash hands with an acid neutralizing-type hand cleaner and rinse thoroughly with water immediately after handling chemicals and several times a day when using chemicals.
- Do remember the importance of avoiding skin contact with chemicals or chemically contaminated surfaces.
- Do clean up promptly any spills of chemicals or chemical solutions.
- Do use cool water for dissolving strong alkalies such as sodium hydroxide or potassium hydroxide.

should be maintained for chemicals that react violently with each other, to diminish the danger. For example, do not store potassium permanganate near glycerin or cyanides near acids.

- Do take every precaution when handling acid and caustic chemicals so they will not come in contact with the skin. These chemicals, when in contact with certain other materials, will heat until they are hot enough to start fires. In addition, strong acids give off toxic fumes that should not be inhaled.
- Do remember that acetic acid freezes at 60°F. Always ensure protection against this.
- Do make sure that shelves are sufficiently sturdy for the storage of photographic chemicals. Also, the shelves should have suitable guard rails to prevent the chemicals from sliding, rolling, or falling off the shelves.

DO NOT'S

- Do not underestimate glacial acetic acid. This is one of the most dangerous chemicals handled in the darkroom. It is a fire hazard, an explosive hazard, causes serious burns, and yet is sometimes handled carelessly. Because it is used in weak solutions, personnel fail to be impressed with its dangerous potentials in concentrated form. It is also very dangerous in contact with chromic acid (photographic tray cleaner), sodium peroxide, or nitric acid.
- Do not handle acetic acid in a confined space. Always ensure plenty of ventilation. Acetic acid fires can be extinguished with water spray or fog, with carbon dioxide, dry chemical (sodium bicarbonate) foam, or other blanketing or smothering type of extinguishers.
- Do not procure acetic acid stronger then 28% concentration.

peroxide as a hypo eliminator is comparatively safe, but the increased uses of this chemical have resulted in its sale in concentrations of 30% to 70% solutions. Hydrogen peroxide in these strengths is a dangerous fire hazard, as well as a dangerously corrosive agent if it touches the skin or eyes. When heated, shocked, or contaminated with catalytic decomposition agents, such as metals and their salts, dusts, and alkalies, hydrogen peroxide is highly explosive and constitutes a disaster hazard. Never, under any condition, procure this chemical in strengths greater than 30%, and do not use a 30% solution even in attached chemical control laboratories unless it can be handled properly.

- Do not add water to acid, always add acid to water. If water is added to the acid, it may cause the acid to generate a sudden heat sufficient to cause the solution to boil and splatter on you.
- Do not mix photographic chemicals in thick glass containers. Rapid temperature changes generated by chemicals in reaction cause regular glass containers to break more easily than thinner containers, whose characteristics of viscosity or elasticity react to thermal expansion or contraction with less danger of breakage.
- Do not mix an acid and a cyanide; this mixture produces a lethal gas.
- Do not place acids diluted with water into steel containers, because acids in dilution attack steel rapidly. Concentrated acid can be stored in steel drums and cans because it will not attack steel.
- Do not store photographic chemicals unless containers are plainly marked as to content.
- Do not start siphoning action when transferring chemical solutions through tubing by sucking on the siphoning tube.

FOR LIC CANDIDATES ONLY

The following information on silver recovery is required for LIC candidates only. LI3, LI2, and LI1 candidates are not required to read this designated section.

SILVER RECOVERY

As you learned earlier, the undeveloped silver halides in the photographic emulsions are dissolved in the fixing solution/hypo. These silver halides were produced from metallic silver bars. In the processing of photographic, photolithographic, and X ray film, significant amounts of pure silver are generated in the fixing solution as a result of the chemical action of fixing. Therefore, the recovery of this valuable silver is of importance to the government.

You may feel that your individual shop does not create enough fixing solution over the months to make it worthwhile to go to the effort of saving, transporting, and processing. However, you should consider that your command might have a hospital, dispensary, dental clinic, photographic laboratory, and/or a hobby craft shop where fixing solutions are used. If so, then you should combine your fixing solution with the solutions of these places.

Recovery of silver from the fixing solution can be accomplished by chemical precipitation, metal displacement, or electrolytic methods.

For further information on silver recovery, you should refer to the *Silver Recovery Program*, NAVPUBINST 4010.1 series.

SUMMARY

To understand photographic materials and how to use them in your work, you must be familiar with the fundamentals of chemistry and physics. Although acids and bases used in photographs can be extremely poisonous or caustic, they are necessary in lithographic work.

In the production of photographic negatives and positives, acids, bases, and salts will work on each other to produce the required images. Acids and bases must be tested with litmus paper to determine their value and to express their numerical values (pH value).

The pH values allow you to have control over your chemistry in photography, as the acidity and alkalinity react with your required photographic product.

The particles of silver halide suspended in gelatin make up the composition of photographic emulsions. These particles are light sensitive and the film base holds them in place. The film base used in your photographic work must be made of a material that will not shrink or stretch with changes. A material that will shrink or stretch will change the size of your finished product image and make the product not usable.

Photomechanical films used in lithography generally contain dye between the light-sensitive emulsion and the base. The dye eliminates internal reflection.

Film records light based on how it is manufactured. Some films are manufactured for only black and white work, while other films are manufactured to record color differences. By adding certain sensitizing dyes to the film emulsions, the manufacturer extends the film's sensitivity to the spectrum. After film is developed, the difference in density on the negative is expressed as contrast. High contrast films are used in lithography because of the required photographic products.

Although there are all kinds of films available, the Navy Lithographer uses photomechanical (process) film. These films are designed for line and halftone photography. The production of the line and halftone negative is discussed in the next two chapters.

To choose the sensitivity (speed) of an emulsion, it is necessary to refer to the manufacturer's information sheet found in the film container. ISO numerical values are assigned to the process film according to the emulsion's relative sensitivity to light. These numbers are used in calculations to determine the required exposures.

Also, to aid you in selecting the required films, you should use film characteristic curves. These curves plot the varying densities based on exposure times. These graphs are normally provided by the film manufacturer on information sheets boxed with the film.

After the required exposures have been made to your process film, it is then transferred through various solutions (processed). As the film is processed, it is said to be developed, stopped, fixed, washed, and dryed.

The developer used in processing lithographic film is manufactured as a concentrate and mixed with water. For best results in the darkroom, the temperature of processing solutions should be kept at 68 °F. At any other temperature, the quality of the image will be affected, because the development of the image will occur either too quickly or too slowly.

Film development time is affected by the amount of light striking the emulsion of the film. Normally, film should develop in 2 to 5 minutes. To aid you in finding the appropriate time for development of a film, you should use time-temperature charts. These charts are found in the film container and produced by the manufacturer of the film.

If you are unable to control the temperature of your processing solutions, you should inspect your film over a light table during development because the change of temperature will affect development. Also during development, the amount of agitation of the developer containing the film will affect the final photographic product. After development, some camera operators use a short-stop bath to save the life of the fixer solution and keep the emulsion from blistering on the film. The short-stop bath solution is a mixture of acetic acid and water. When you place film in this solution, the development of the film stops instantly.

A fixing solution is used to dissolve the unexposed areas of the film emulsion. Fixing solution is commonly called hypo in the lithographic field. After the film negative is clear, it is no longer sensitive to light. Then, the negative should be washed and dryed. Washing the negative can be completed in 10 to 20 minutes, depending on the water temperature. Drying of the film can be accomplished using room air, hanging the film on drying lines, or using drying machines.

Your required processed negative must possess dense black areas and clear, open spaces corresponding to the original copy. If the negative overdevelops, thin lines will fog (or fill in) on the negative. You can use a solution known as Farmer's Reducer to clear (reduce) these areas of the negative.

If your negative does not have the required density, you can use solutions of potassium bromide and mercury chloride, and sodium cyanide and silver nitrate (known as Monckhoven intensifier). These solutions are known as intensifiers because they build density on the negatives.

Photograph print papers are processed basically the same as process film and are available in various grades and types for the production of photographic positive prints. Photographic contact print papers are manufactured in varying degrees of contrast, and their emulsions are almost entirely silver chloride. For best results, you should use the correct contrast print papers required for your job.

While standard process films produce a reverse image of your original copy, you can produce the opposite effect directly by using special films. For example, to copy directly a negative from a negative or a positive from a positive, you should use either duplicating or autopositive films.

The chemicals and chemical solutions used in photography are extremely dangerous when handled improperly. Therefore, you should always be aware of the manufacturer's warnings printed on labels, boxes, and other containers used in your shop. Proper storage, handling, and use of photographic materials in your shop are your responsibility.

Information on the Navy's silver recovery program is provided for all paygrades, but particularly for LIC candidates. Fixing solutions can be combined with fixing solutions of other shops in your area. Therefore, by collecting, storing, and turning in your used fixing solution, a great savings can result to the U.S. Government.

Production of the line negative is presented in the next chapter.

CHAPTER 7

PRODUCTION OF LINE NEGATIVES

A designated section of this chapter contains information required for LIC candidates only. This section will be prefaced For LIC Candidates Only. LI3, LI2, and LI1 candidates DO NOT have to read the designated section. However, junior LIs serving as LPOs may find the information of interest.

As a Navy Lithographer serving as a camera operator, you will be required to produce line negatives from original copy. For the majority of your work time, you will be operating the process camera and producing line negatives in the darkroom. This chapter will present the types of equipment, their operations, and the procedures used in the production of line negatives.

As you proceed in the production of these line negatives (or any negatives), keep in mind how important the negatives are to the finished product. Although the platemaker and offset press operator are able to overcome many problems caused by poor quality negatives, negatives that are exposed and processed in the required manner always yield the best results. Most high-quality offset printing jobs can be traced to negatives that were exposed and processed in the required manner.

STANDARDIZATION

To obtain consistent results in photolithography, standardize your operations whenever possible. Guesswork and haphazard methods invariably result in poor work in addition to a waste of time and materials. If you use the same materials in the same way each time, you can expect to have uniform results.

When you are working and a change in your operation is necessary because of problems, then make just one change at a time to the operation. For example, in the darkroom the image on your film develops too slowly. This is probably a result of either underexposure or old developer. To correct this problem, you should make an exposure adjustment and check your developer. In this instance, you should check your developer first and then replace it if necessary. Now, process another piece of film at the same exposure setting. If your developer is fresh or checks out satisfactorily but the image continues to develop too slowly, then you should make an exposure setting adjustment. By making one change or check to your operation at a time, you are able to isolate the cause of the problem and observe the results of changes you have made in the final product. After you have corrected the problems, you can continue making your exposures. Once again standardization of your operation has been achieved and results are uniform.

THE COPY

As a camera operator planning the camera setup, you should consider the original copy as the most important factor.

From this copy you must decide the following:

- The position of the camera lamps
- The proper lens aperture opening and exposure time
- What type of film to use
- Which filter, if any, to use

Your camera lamps are positioned so that their light uniformly covers the area of your copy. The position of these lamps is mainly affected by the size of the original copy.

Most camera operators shoot line work from the surface on which the image is prepared (the background). This background surface registers (as the black areas) on the negative. If your copy is prepared on a tinted or colored surface (paper stock) or on stock having a rough surface, less light is reflected into the camera. Now a larger aperture opening or a longer exposure is necessary. However, if the copy is prepared on a smooth, white stock, the aperture opening or the exposure time will be less. There is no formula for determining how much change these factors of surfaces and their color could affect apertures and exposure times. This is something you must learn from experience and test exposures.

If copy background is too dark to correct with just aperture opening and exposure time, it may be necessary to use another type of film or use a filter.

FILTERS AND FILTER FACTORS

A filter is colored glass or a thin sheet of film or gelatin that fits inside or in front of the camera lens. As you select the filter for your camera work to produce the best possible finished line negative, you must consider the film being used as well as the background of your original copy. During manufacture, different films are made with different sensitivity to the color spectrum. Therefore, different colored filters must be selected for each of your line shots with different colored or tinted backgrounds. For example, if the copy you are shooting has a yellow color in its background, you should use a yellow filter. Use of the yellow filter will cause the film to register the background as a dense, black area on the negative. The correct filter used to shoot a particular piece of copy will reduce or filter out selected colors of light reflected from a piece of original copy. The film you use with the filter selected will record only the colors transmitted through the filter.

Because the filter absorbs part of the light in the lens, you must now increase the exposure time. The term *filter factor* is used to describe the number of times the exposure must be increased, depending on the film, filter, and light source selected. This filter factor appears numerically. For example:

2.5, 3.0, or 16, and so forth

See figure 7-1 for an illustration of how information on filter factors might be presented in the box of film by the film manufacturer.

To help you select the required filter and film for your line work, charts and information sheets are provided in boxes of film from the manufacturers.

FILTER	LIGHT SOURCE	
	PULSED XENON ARC	TUNGSTEN QUARTZ-IODINE
GREEN (58)	3.0	2.5
BLUE (47B)	16	25
DP. YELLOW (15)	5.0	2.5
LT. YELLOW (K1)	2.0	1.5

57.711

Figure 7-1.—Filter factors for one type of film.

STEP-BY-STEP OPERATIONS

The procedures that are followed to obtain line negatives in this chapter are not written for any particular model camera or darkroom equipment. However, examples and illustrations will focus on horizontal process camera. The equipment you will use will vary from shop to shop. There are slight differences in copyboards, lensboards, and focusing systems of cameras. Bear in mind that although the physical structure of equipment varies, the principles of photography remain the same and operating procedures are usually similar.

CHECKING THE COPY

Before attempting to make a negative, you should carefully inspect the original copy for its overall condition and quality. If the copy has had rough treatment, it could show smudges in the type or the paste-up areas could be loose or folded over. The quality of the copy should be checked, particularly for contrast between copy and background. The lines of the original copy should be clean and sharp for best results. If you find any of these problems while you are checking the copy, you should correct them before proceeding further.

Also check the copy for any special instructions to the camera operator that might be written in the margins of the copy. Check the job order or job jacket for instructions, and for the number of originals, for the number of negatives needed, and so forth. In most cases, the percentage of enlargement or reduction required will be provided on the job order or the job jacket. However, if it is not provided, you will have to calculate it yourself. The quickest and easiest way to calculate the percentage of enlargement or reduction is by using a scaling wheel with your original copy. Percentage of enlargement or reduction can also be calculated mathematically. Both methods of calculating were discussed in detail in chapter 3 of this manual.

MOUNTING THE COPY

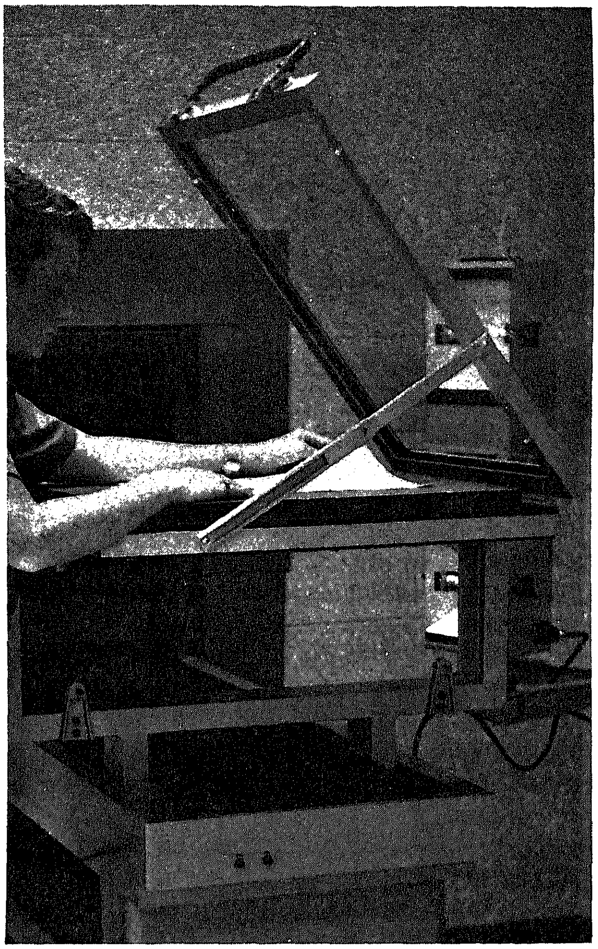
To mount the original copy in the copyboard, you should release the catch at the base of the copyboard and tilt it to the horizontal position. When the copyboard reaches the horizontal position, it will lock into position with another catch.

Next, check the copyboard glass to see that it is clean on both sides. If the glass is not clean, you can clean it with a glass cleaner before proceeding. Now you can mount (place) the copy in the center of the copyboard, with the top of the image towards the lensboard of the camera. (See fig. 7-2.) You can find the center of the copyboard by using the reference marks on the bed of the copyboard. If your original copy has large, white margins, you might need to cover these margins with strips of black paper to reduce glare during your exposure. Once the copy is in place, close and lock the glass over the copy. If your copyboard is equipped with a vacuum system, you will now have to switch it on and turn the copyboard vacuum control to the ON position to hold the copy in place. If your copyboard is not equipped with a vacuum system to hold the copy in place, then the spring system on the bed will be used.

As soon as the air has been vacuumed from the copyboard frame, you can make all required camera settings and the exposure. After the exposure is made, unlock the catch and return the copyboard to the horizontal position, where the board will again lock in place. If necessary, turn off the vacuum; then open the glass and remove the copy. The copyboard should always be returned to the vertical position and locked in place as soon as possible.

SETTING THE CAMERA LAMPS AND LENS

As a rule, camera operators keep the camera lamps at a predetermined angle and distance from the copyboard. Most camera operators have two positions for the lamps: one for normal work and another for larger copy. Although it may differ, lamp-to-copyboard distance for normal work is generally 3 feet. At the start of each day, check the lamps to ensure that they are working properly and that all the elements are lit.



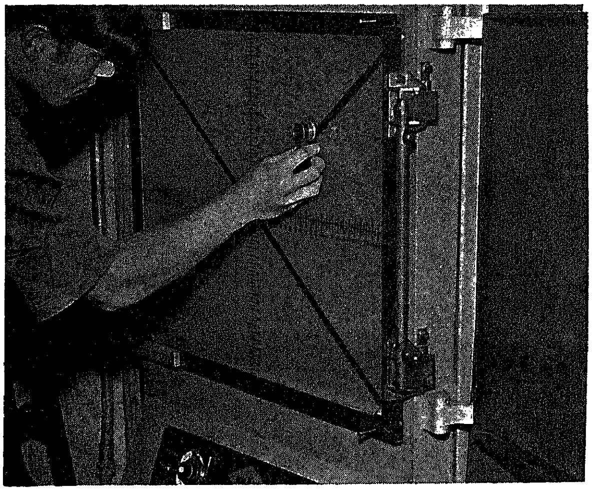
57.712X

Figure 7-2.—The copy is mounted in the center of the copyboard.

After the lamps have been checked, set the lens to the correct f/stop. A setting of f/22 for same-size work is accepted as standard by most authorities.

FOCUSING THE CAMERA

After you enter the darkroom, your next step is to focus the camera. The copy image is brought into focus by turning the handwheels that position the copyboard and lensboard. Their respective positions are indicated to you by the metal tape readings seen in the tape viewing window. Most process cameras have a red safelight in their viewing windows to aid you in accurately reading the tapes. If you are using panchromatic film, you will have to turn off these lights before loading the film on the vacuum back. Otherwise, you will expose the film because of the panchromatic film's sensitivity to red light.



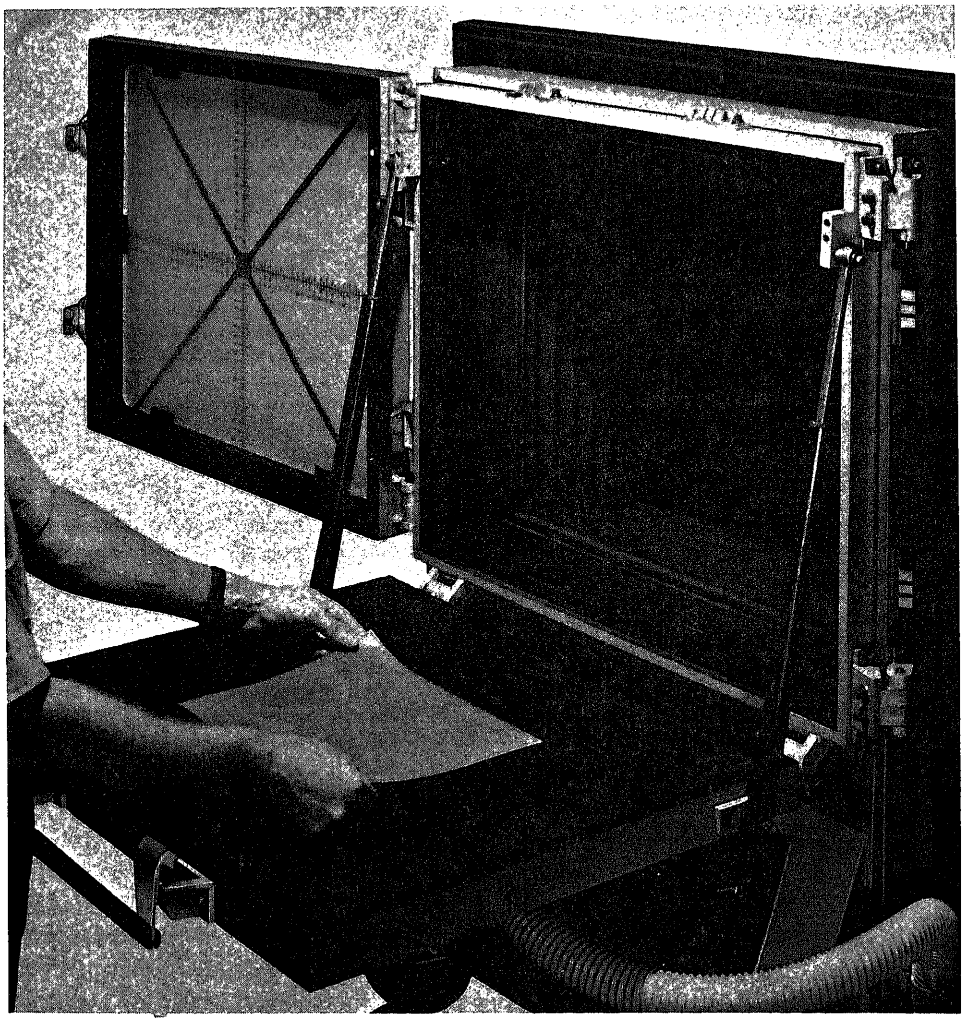
57.713X

Figure 7-3.—Critical focusing at the ground glass.

If test negatives have shown that the camera scales are accurate, you may focus most jobs by just using the handwheels and tape readings. If they aren't accurate or if the job is critical, it will require further visual focusing.

To focus the camera visually, move the lensboard and the copyboard until you reach the required settings on the tapes. Then, move the vacuum back either down or to the side, depending on the model camera you are using. Now, you can move the ground glass into the camera's focal plane. Next, set the master (camera power) switch on the control panel to the ON position, and then open the shutter and turn on the camera lamps. (This is normally done by moving the lamp shutter switches to the manual positions.)

Measure the image on the ground glass with a ruler. If further adjustments for size are necessary, first move the lensboard; then relocate



57.714X

Figure 7-4.—The film is loaded on the vacuum back.

the copyboard and bring the image into focus. If the image consists of fine lines, you should examine it with a linen tester (magnifier) to ensure that the image is in sharp focus. When the size is correct and the image is sharp, lock the copyboard and lensboard in position.

When focusing the camera visually, camera operators sometimes prefer to have the lens diaphragm wide open, because the wider opening allows more light to enter the camera and produces a brighter image on the ground glass. This is not necessary, as a rule, if the focal length of the lens is over 10 inches, but it is useful for lenses with short focal lengths. Once the image is in focus, you should stop the lens down (set to the required f/stop) to the aperture you will use for the exposure. Here you should again check the focus. This is necessary because the focus sometimes changes as the lens is stopped down. In such cases, it is necessary to focus the camera at the aperture to be used for the exposure. Fine-line work should always be focused with the aperture to be used for the exposure, and the image should be examined with a linen tester before the exposure. As you can see in figure 7-3, there are small, clear spaces on the ground glass. These clear spaces are the best places to place the linen tester and check critical focusing.

Once you have locked your required focusing settings down, focusing is complete.

LOADING THE FILM

With the focusing finished, you can now switch off the camera lamps and close the shutter. Move the ground glass out of the focal plane and move the vacuum back to its loading position; then, center the film. (See fig. 7-4.) Reference lines are located on the vacuum back to aid you in centering the film.

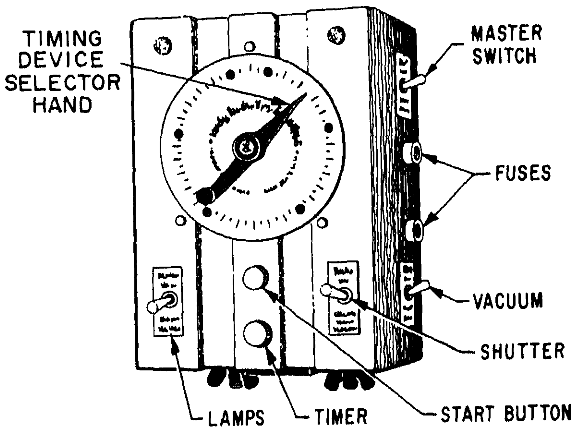
The film must be loaded on the vacuum back with the emulsion side up. The emulsion side of the film must face the lens when the vacuum back is closed for the exposure. If you are using color-blind or orthochromatic (ortho) film, you can determine the emulsion side by examining the film at a reasonable distance from the safelight. The emulsion side of the film is always lighter in color and has a dull finish. If you are using panchromatic (pan) film, you must work in total darkness. However, the emulsion side of pan film can still be found easily because pan film is made with notches in the upper right-hand corner. The notches indicate that the emulsion side will be facing you. Another method for determining the emulsion side of film is to moisten your thumb and index finger and press a corner of the film between them. The emulsion side of the film will stick to either your thumb or your index finger. Any part of the film that was moistened to determine the emulsion side, or for any reason before exposure, will not record light properly.

After the film has been centered on the vacuum back, the vacuum control can be turned on. With the vacuum control switched on, the film is sucked into flat contact with the vacuum back. The vacuum will hold the film in place so that you can move the vacuum back into the camera focal plane and lock it in place for the exposure.

EXPOSING THE FILM

With the copy and film loaded in the camera and the camera set up for your shot, you are now ready to expose the film. The camera you are using will have the same controls as the panel shown in figure 7-5. But the controls on your control panel might be arranged a slightly different way. Notice that in addition to the individual switches that control the power supply, the camera lamps, and the shutter, there is also a timing device.

To set the camera control panel for an exposure, you should place the lamp and shutter switches in the automatic position. Also, place the power switch in the ON position. The timing device is set by moving the selector hand to the desired number printed on the device. Now press the start



57.113.7

Figure 7-5.—A camera control panel.

button, which simultaneously opens the shutter and energizes the lamps and timing device. When the exposure time is completed, the shutter closes and the camera lamps are turned off automatically.

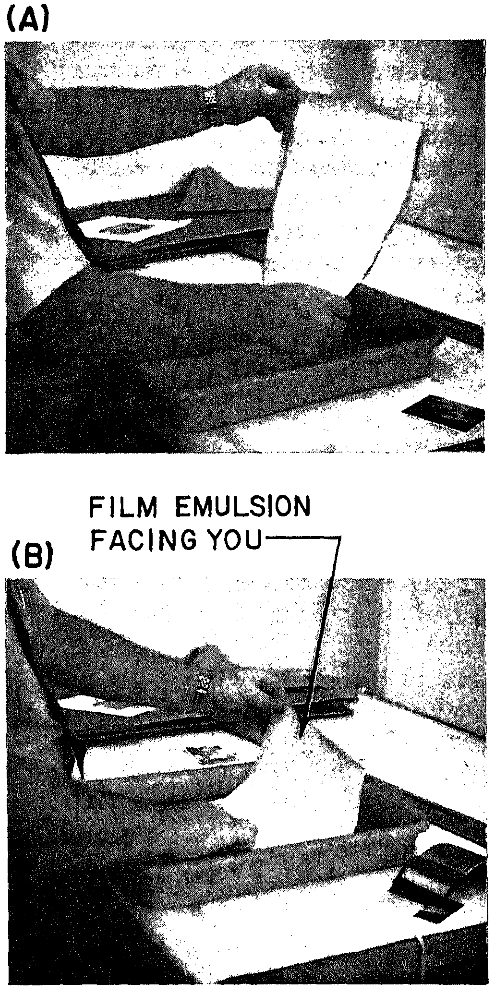
It is impossible to state here an exact exposure time for every particular film and camera setup. However, you can find a recommended exposure time on an information sheet located in your box of film. Since your camera setup varies, your exposure time will also vary. The age and ISO speed of the film you are using as well as the makeup of your original copy are also factors that will affect the length of your exposures.

FILM PROCESSING

When you are processing (developing) film, your darkroom should be air-conditioned to maintain constant-cool temperatures. If your darkroom is equipped with a temperature-controlled sink, you can expect to obtain uniform results when developing negatives using the time-temperature developing method. However, if your darkroom sink is not temperature-controlled, you should keep a thermometer in the developer. Then you can check the temperature and refer to a time-temperature chart to determine possible changes in developing times.

Once you have determined the correct development time, set the darkroom timer for the amount of time required. Immerse the film uniformly in the developer by first drawing the film, emulsion side down, quickly through the developer. (See fig. 7-6.) Then quickly flip the film over and let it rest on the bottom of the developing tray. During the development, you should agitate the developer continuously with a smooth, rocking motion of the tray.

When the developing time has elapsed, remove the film from the developer and place it in the stop bath solution to quickly stop all development. After 10 to 15 seconds in the stop bath, place the film in the fixing solution. When the milky appearance in the image areas of the film is no longer visible, the negative is no longer sensitive to light because all of the unexposed silver salts of the emulsion have been dissolved. Now, you can turn on the white lights in the darkroom as long as all unexposed film in the darkroom is stored in lighttight containers. The total time that the negatives must remain in the fixing solution varies according to the type of film and fixing solution you are using.



57.715

Figure 7-6.—To begin development, the film is quickly drawn through the developer (A); then it is flipped over with the emulsion side facing up in the tray (B).

You can determine the correct amount of time to completely fix your negatives by checking the information sheet found in the box of film. After fixing the negative, you should wash it thoroughly in running water to remove all traces of the processing solutions. Usually, the negative should be washed for a minimum of 10 minutes. If you are aboard ship and freshwater is in short supply, the negative can be washed in salt water first. To complete the washing, however, use fresh running water for the last few minutes of the wash.

INSPECTION

After the film negative has been processed, you should inspect it visually for quality. It is not necessary to dry the negative completely before inspecting it; lay it on a clean, flat surface, emulsion side down, and run a squeegee over it to wipe off the excess water.

To inspect the negative, place it on a light table, emulsion side down, and examine it closely through a linen tester. You should compare your negative with the original copy. A properly exposed and processed negative will have clear, sharp, transparent (image) areas. Also, the black (non-image) areas will appear dense throughout with few pinholes. Always check your negative to ensure that it meets all the requirements of any special instructions you received and to ensure that all of the image is on the negative.

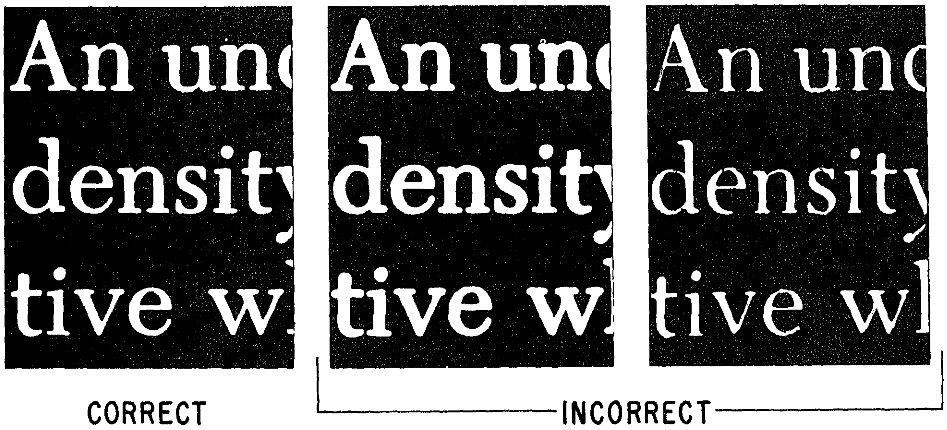
Compare your negatives to the samples shown in figure 7-7. As you can see, the correct negative has sharp, clear, transparent (image) areas. The other two negatives are incorrect and not acceptable. These incorrect negatives either lack the sharp detail in the image or the image areas are missing. When you are checking negative quality, have a specific point in mind. Some experienced camera operators use the small openings in the letters *A* and *e* to check for quality; others look at the tips of the letters *m* and *w*. If the images are sharp and clear in these areas, the negative should be acceptable.

There are some shortcomings in negatives that can be corrected in either stripping or platemaking. You will learn more about these shortcomings and the methods of correcting them in later chapters in this manual. However, you should remember that the quality of your negative has a great effect on the printing plate and the final product you will be producing. Therefore, to get the final product desired, you may have to re-shoot a negative several times.

THE CAMERA OPERATOR'S DAILY DOZEN

The camera operator should perform certain operations daily for the successful performance of the camera and darkroom equipment. The following operations are known as "The Camera Operator's Daily Dozen":

1. Check and clean the camera.
2. Clean the utensils and prepare the solutions.
3. Check the copy for defects; check the sizing and instructions. If necessary, use a scaling wheel to find positions for copyboard and lensboard tapes and proper aperture opening settings.
4. Make test exposures of copy or film to test for best results.
5. Mount the copy in the center of the copyboard; cover unnecessary white margins with black paper.
6. Adjust the copyboard and the lensboard for enlargement or reduction as required.
7. Check the camera lamps; set the aperture opening. If visual focusing is necessary, open the shutter and turn on the lamps; then check the focus on the ground glass at the camera back.
8. Set the lamp and shutter switches to automatic positions when focusing is complete; set the time for the exposure required.
9. Mount the film on the vacuum back; swing the vacuum back into place and lock it.



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10. Flip the switch to open the shutter and turn on the lamps. At the end of the required time, the shutter will close, and the lamps will turn off automatically.

11. Develop the negative for the required time; then rinse, fix, and wash it.

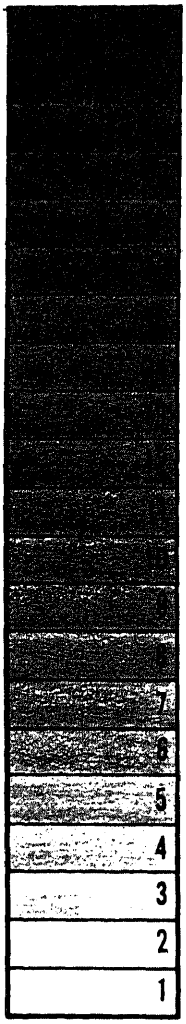
12. Examine the wet negative for quality over a light table. After the negative has dried, check it against the copy for size and detail.

SENSITIVITY GUIDES

When camera operators are photographing line copy, they sometimes use a sensitivity guide (another form of gray scale) similar to the one shown in figure 7-8. The sensitivity guide is used as a visual aid to determine when the correct development of line negatives has been attained. To use the guide properly, you should place it in the center of the copy. However, when it is placed in the center of the copy, it could cover part of the image; therefore, the sensitivity guide should be placed in an open area of the copy. The image of the guide as it appears on the film during film development is used as a gage. This gage indicates when the film has been developed to the correct point. The camera operator refers to a chart that shows which step on the sensitivity guide should be developed solid black for the copy being photographed. (See fig. 7-9.)

For example, you can see from the chart that for normal copy shot at 40% to 120% of original size, step 4 on the guide should be developed solid (black) to obtain a negative of the correct density. If the same shot is being made of copy that consists of light lines, step 3 should be developed solid (black) to obtain the correct negative density.

The sensitivity guide must be cut from the negative or masked out when the negative is stripped into the flat in the stripping area of your shop. There are similar sensitivity guides that may be used in platemaking. Those guides will be discussed in the chapter on platemaking.



57.183B

Figure 7-8.—A sensitivity guide.

DENSITY OF COPY	SIZE OF COPY		
	10-40%	40-120%	120-400%
	STEPS	STEPS	STEPS
EXTRA HEAVY COPY BLACK BOLD TYPE ETCHING PROOFS PHOTO PROOFS	4 BLACK	5 BLACK	6 BLACK
NORMAL COPY GOOD BLACK TYPE PROOFS WITH FINE SERIFS PEN AND INK DRAWINGS PRINTED FORMS	3 BLACK	4 BLACK	5 BLACK
LIGHT COPY GREY COPY ORDINARY TYPEWRITTEN SHEETS PRINTED FORMS LIGHT LINES GOOD PENCIL DRAWINGS	2 BLACK	3 BLACK	4 BLACK
EXTRA LIGHT COPY EXTRA FINE LINES PENCIL DRAWINGS EXTRA LIGHT GREY COPY	1-2 BLACK	2 BLACK	3 BLACK

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57.717X

Figure 7-9.—Chart used with the Stouffer Sensitivity Guide.

POSITIVE COPIES

Occasionally, your work will require you to make positive copies of film for overprints or for other purposes. You can make these positives with the enlarger, with the process camera, by contact printing, or by using reversal-type film.

Using the enlarger to make positives, you would proceed as if you were making enlargements on photographic paper. To make a positive on film with the enlarger, place the original negative in the carrier, then focus the image on the easel of the enlarger. Now you can place your process film in position to accept the focused image and expose the film. Remember, most process films have considerably faster emulsions than a photographer's photographic enlarging papers; therefore, you must decrease your exposure (time and/or aperture) accordingly.

To make positive copies on film, you should place the original negative in front of the process camera lens on a piece of opal glass. Put a lamp behind the glass and negative for back illumination. Opal glass is a white, translucent glass, similar to the ground glass at the camera back. Some types of process cameras have a cutout in the center of the copyboard where opal glass may be mounted for backlighting exposure of negatives and transparencies. The light from backlighting exposures could cause unwanted reflections; therefore you should avoid letting the light shine directly into the lens of the camera. To keep the light out, some camera operators construct a light tunnel from sheets of index paper and mount the tunnel from the lens to the original negative.

When using the process camera to make your positive copy, you can either make the copy image the same size or change it (reduce or enlarge), depending on how your camera is set up. After the negative is mounted with the required backlighting and the camera is set up, you may expose the film. Once this is done, a positive is produced.

To make a contact print positive on film, you should place the original negative over a piece of film (emulsion to emulsion) in the vacuum contact printer. Next, you can close the frame, exhaust the air from the frame, and expose the film. The exposure should be made using a weak, diffused light placed far enough from the film's emulsion so that an exposure of 10 seconds or more can be used. To obtain this lighting, you may require a small light bulb in a safelight housing or a variable-density filter over the light source.

Reversal-type films, such as autopositive and duplicating films, are used to produce positive copies of negatives. Generally, reversal films are used in a vacuum printer, as discussed in the last paragraph. However, these films are exposed through amber sheeting to eliminate all blue and blue-violet light. When exposing reversal films, you should use a strong light source, such as a pulsed xenon lamp. Reversal films are processed basically the same as normal line shots. During development, there is continuous agitation (the tray is rocked constantly throughout the developing period). Packed inside of each box of film are information and specific instructions for the various types of direct positive films. In some shops reversal films are frequently used to make duplicate (backup) negatives of important jobs.

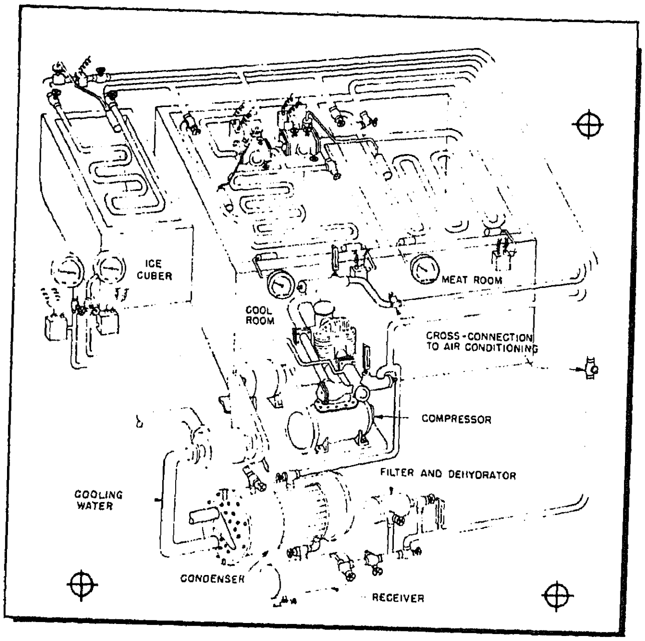
NEGATIVES FOR COLOR REPRODUCTION

Regulations regarding Navy color printing are set forth in the *Department of the Navy Publications and Printing Regulations Manual* (NAVSO P-35). In general, color should not be used for decorative purposes; color should be used only when the color has a functional value. For example, a different color of ink might be used for a part of the text in printing a job if that particular part served as an important warning. Whenever you have questions regarding color printing in your Navy work as a lithographer, check the *Department of the Navy Publications and Printing Regulations Manual* (NAVSO P-35).

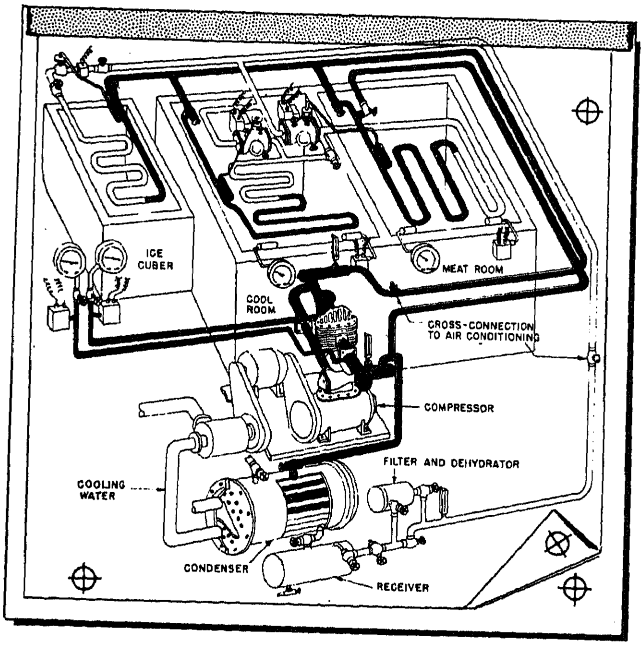
As you work with color in a print shop, you will find it easy to make the needed line shot negatives if the copy has been properly prepared. If the colors do not overlap each other in your copy of, say, a simple black-and-white drawing, then you should prepare the copy as follows:

Attach a tissue overlay to the drawing and indicate on the overlay the areas that should go in color. You can also notate on the overlay the colors to be used. Then, from the original, shoot one negative for each color to be printed in the final product. Next, mask off the negative for each color so that only the desired color image areas will be exposed on the lithographic offset plate. If the color work is simple, you might be able to use a paper mask and move it around over the top of a single negative during platemaking.

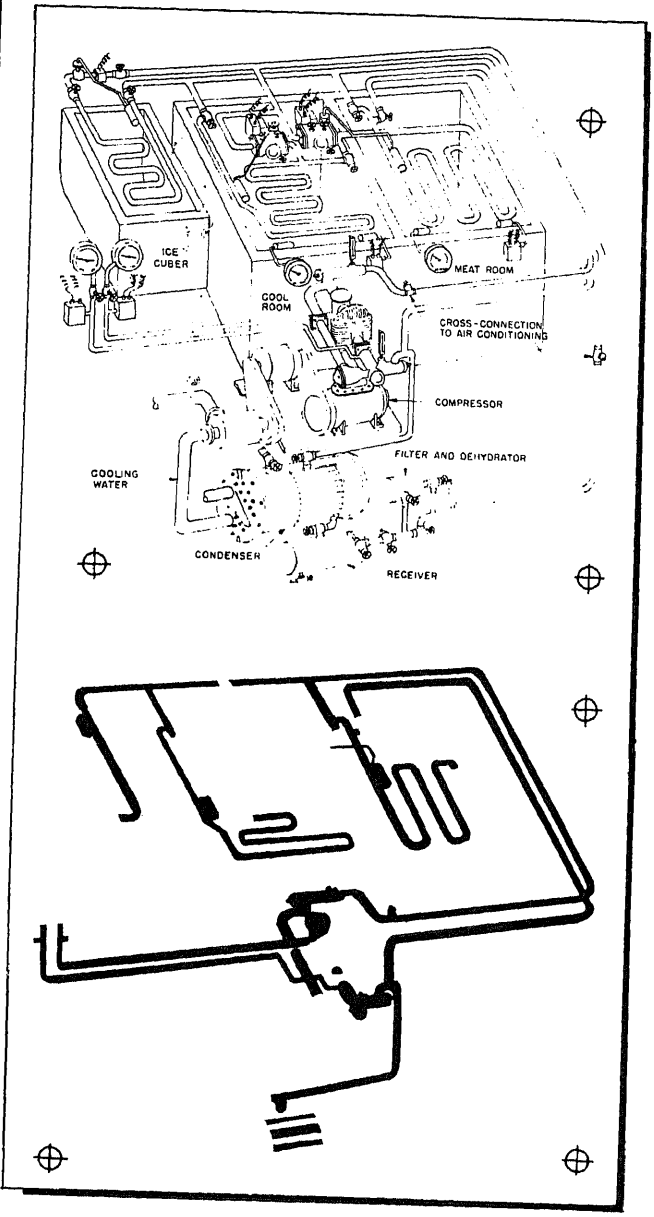
When your printing job requires colors to overlap, you should be working from a separate black-and-white drawing on acetate for each color



THE ARTWORK FOR THE BLACK (OR THE MAIN COLOR) IS DRAWN IN BLACK INDIA INK ON WHITE DRAWING BOARD.



AN ACETATE OVERLAY IS ATTACHED TO THE DRAWING AND THE MATERIAL FOR THE SECOND COLOR IS DRAWN IN ON THE ACETATE IN BLACK INK.



THE ACETATE IS MOUNTED BELOW THE DRAWING FOR THE MAIN PLATE AND THE CAMERAMAN SHOOTS IT AS ONE SHOT, CUTTING THE NEGATIVE TO MAKE TWO SEPARATE PLATES.

Figure 7-10.—Artwork prepared for a two-color job. Acetate overlays are often used for black-and-white work also. For example, when lettering or line work is superimposed on a halftone. **57.115**

and then make a separate negative from each drawing. Figure 7-10 illustrates artwork prepared for a two-color-line printing job.

If your copy is prepared in color and you must use that copy as an original for your color printing, you might have to use filters to make your negatives. Remember, we said earlier in this chapter that filters drop out certain colors; therefore, the use of filters will help you to produce the negatives required for each different colorplate. Sometimes, however, it may be easier to ask the artist to re-do the copy in black and white.

COLOR COPY

If you use the proper type of film, you may be able to photograph colored copy without the use of filters. Sometimes, however, there is so little contrast between the subject and the background that filters are indispensable. When the subject is to be made dark against a light color background, you should select the filter that will transmit the color of the background and absorb the color of the subject, so that it will photograph as black on the negative. Figure 7-11 shows combinations of filters and films used to photograph various colors. Because of variations in film emulsions and specific color hue, you may have to use combinations of filters when shooting some copy.

FILM AND FILTER GUIDE				
FILTER TO USE TO PHOTOGRAPH AS BLACK (HOLD)			FILTER TO USE TO PHOTOGRAPH AS WHITE (DROP)	
PANCHROMATIC-ORTHOCHROMATIC		COLOR	PANCHROMATIC-ORTHOCHROMATIC	
C5	NONE	RED	A	-
K2 or G	K2 or G	BLUE	C5	C5
C5	C5	YELLOW	A or G	K2 or G
A	C5	GREEN	B	B or K2
B	K2	VIOLET	C5	C5
B or C5	C5	ORANGE	A or G	K2 or G

WRATTEN FILTERS ARE DESIGNATED AS FOLLOWS:

A	RED (#25)	G	DEEP YELLOW (#15)
B	GREEN (#58)	K1	LIGHT YELLOW (#6)
C5	BLUE (#47)	K2	YELLOW (#8)

57.718

Figure 7-11.—Film and filter combinations used to photograph various colors.

If you write on paper with a red crayon and try to read it by only a red safelight in the darkroom, you will find that the lettering is practically invisible. But if you were to look at the lettering under a mercury-vapor lamp, the lettering would appear black because this lamp gives off no red radiation. That is the effect of the filter. Filters transmit some colors freely, making them photograph as white or as light shades of gray on the negative; and they absorb the radiations of other colors, making them photograph as black or as deep shades of gray.

Orthochromatic film is the workhorse of the litho shop because it is suitable for almost all types of work. However, panchromatic film must be used when red filters are required, because orthochromatic films are not sensitive to red. Since the light entering the camera assumes the same color as the filter, no image will register on the film if a red filter is used with orthochromatic film, because all light striking the film will be red.

Whenever you are required to photograph colored copy, you may find the following hints helpful:

1. To DROP a color, use a filter of the same color, preferably darker than the color you wish to drop.
2. To HOLD a color, use a filter that is complementary to the color that you wish to hold.
3. To intensity pencil drawings, use a green filter.
4. To obtain a negative of a blueprint, use panchromatic film and a red filter.
5. To intensify the blue when the copy you are photographing has a signature in blue ink, use a yellow filter.
6. Yellow stains and other discolorations can often be dropped from the negative by use of a yellow filter. If the stains are severe, however, it may be necessary to retouch the copy to obtain a satisfactory negative.
7. Overexposure will help to drop a color when no filter is used. Underexposure will help to hold a color when no filter is used.

FOR LIC CANDIDATES ONLY

The following information on Classified Material is required for LIC candidates only. LI3, LI2, and LI1 candidates are not required to read this designated section.

CLASSIFIED MATERIAL

When you are photographing classified material, precautions must be taken to prevent possible loss and compromise. All personnel handling the classified materials must be cleared for access and should also have a "need to know" the information. No other personnel should be allowed into the camera room and the darkroom areas while the work is in progress.

You must be able to account for all classified materials (including text, photographs, or artwork) and all negatives and positives because you are responsible for their safekeeping.

Negatives and positives you produce that are not satisfactory for use in the reproduction process must still be handled as classified waste when you are doing a classified job.

This classified waste must be placed in approved storage containers (safes, vaults, and so forth) until the waste can be properly destroyed according to procedures approved for destroying classified waste materials.

Classified film negatives and positives cannot be destroyed by shredding and pulping; they must be destroyed by burning. Some paper negatives may be destroyed by reducing the negatives to pulp. If your lithographic shop uses a pulping machine for destroying classified material, then always run a test of unclassified photographic papers first. If the tests are successful then you can use the same procedures for pulping classified photographic papers.

SUMMARY

This chapter presented skills that the Navy Lithographer needs to produce line negatives with the equipment and materials most commonly found in Navy lithographic shops. When you produce line negatives with your equipment, standardization of your operations will save you time and materials.

As you consider your camera setup for the line shot, you must examine your original copy. This examination will determine the camera lamp positions, the f/stop setting, the exposure time, the type of film selected, and, perhaps, the use of a filter. A filter can be used with the camera to reduce or filter out selected colors in the light transmitted from your copy towards the film. Since the filter, however, blocks some of the light before the light reaches the film, the exposure time must be increased. The number of times the exposure time must be increased is known as filter factor.

In Navy lithographic shops, the physical makeup of your equipment may vary, but the step-by-step operations of the photography remain similar. The copy you are shooting must be clean of smudges, and all lines in the copy must be clean and sharp. You may also get special instructions for the job for perhaps an enlargement or reduction of the copy. So always check the work order for special instructions concerning the original copy.

Care must be taken before you put the original copy into the copyboard frame as the glass of this frame must be kept clean on both sides. Center the original copy in the copyboard with the head of the copy towards the lens. Next, position the lamps so that the light from the lamps will light the entire copy uniformly. Then check and/or set your lens aperture opening before focusing the image.

At this point, you can focus the camera either by using the tapes at the camera back (set the tapes at a predetermined setting) or by viewing the image through the ground glass.

At the camera back with the ground glass in place, the camera is operated for viewing the focusing operation. By turning the handwheel controls as you view the image on the ground glass, the lensboard and copyboard are moved to focus the image at the size needed. When working with fine lines in the copy, you should examine the focused image on the clear areas of the ground glass with the aid of a linen tester. This will show you just how well these fine lines are focused. After you finish focusing the camera, turn it off and remove the ground glass from the focal plane of the camera.

Now bring the vacuum back of the camera into a loading position and load the required film onto the vacuum back. The film is loaded (placed) in the center of the vacuum back, emulsion side up, and the vacuum in the vacuum back is put into operation. The vacuum will hold the film flat against the back as the back is moved and locked in the focal plane of the camera for exposure. The camera control panel is used to operate the camera for your exposure. This control panel has a timer built into it. When you set the timer for the required period of the exposure, it will time the exposure for you. When the time has elapsed, the timer automatically closes the shutter and turns off the camera lamps. The length of your exposure will depend on the copy, the lighting, the f/stop setting, the film selected, and the camera setup.

After exposure, you should remove the film from the camera. It is then ready to be processed (developed). Film processing solutions work best when they are all kept at a constant 68 °F. This temperature is easy to maintain if you use a temperature- controlled sink in your shop. If your shop is not equipped with this type of sink, then use a thermometer in your developer along with a time-temperature chart to aid you in determining development times. After development, place the film in a stop bath solution, which will quickly stop all development. Next, the film is cleared in a fixing solution. The fixing solution also changes the emulsion so that it is no longer sensitive to light by dissolving the unexposed silver salts.

The processed film can now be closely inspected over a light table for quality—even before drying. Here you can even use a linen tester to again check the fine lines reproduced in your negative. The quality of the negative is seen in the clear, sharp, transparent (image) areas and the dense, black (non-image) areas of the negative. Also check your image to ensure that it meets all requirements as to size or any special instructions on the job. If the negative is not acceptable for any reason that cannot be corrected in stripping or platemaking, then you should re-shoot the negative.

A successful camera operator uses the process camera as a primary piece of equipment. Therefore, certain daily operations and/or checks are important factors in maintaining the camera. Because there are twelve steps involved in the operations and/or checks, Navy Lithographers refer to them as The Camera Operator's Daily Dozen.

Sensitivity guides may be used to aid the camera operator in making line shots. These guides are placed on the copyboard with the original copy and they also appear on the film during processing. The camera operator views the varying tones as they appear on the guide. By checking a chart, the operator can see when the development is complete.

Sometimes you will be making positive copies on film with either an enlarger, a process camera, a contact printer, or special films. The steps are much the same, whether you are using the enlarger, the process camera, or the contact printer. However, the special reversal films (autopositive and duplicating) allow you to copy the negative directly without backlighting the original. These films are used with special amber sheeting during exposure with only certain lighting. Specific information on instructions for these special films are found in their boxes.

In color reproduction you adhere to the regulations found in the *Department of the Navy Publications and Printing Regulations Manual* (NAVSO P-35). Navy printing with color should only be done when the use of that color serves a functional value. The negatives used for a color line job are produced the same as any line negative. However, when more than one color is printed in the job, there must be perhaps as many separate negatives as there are colors in the job. Therefore, you might need to shoot the same original many times.

When making line negatives, you might need to shoot an original copy that has color in it. Since colors affect your film differently than black-and-white originals (for which the film is manufactured), you may need to use a filter. The type of filter you choose will depend on the colors found in your original copy, your camera setup, the film selected, and your desired final result.

Information on classified material was provided for all paygrades, but particularly for LIC candidates. All personnel handling a classified job must be cleared for access and must have a need to know to even be in the area. As you photograph original classified text, photographs, or artwork, you must consider all of the products as classified material whether they are used or not.

Production of the halftone negative will be presented in the next chapter.

CHAPTER 8

PRODUCTION OF HALFTONE NEGATIVES

Before the halftone process in lithography had been perfected, actual photographs could not be reproduced. All illustrations consisted of line drawings made from woodcuts (see fig. 8-1).

It was not until Max Levy invented a practical halftone screen in 1893 that photographers took halftone work seriously.

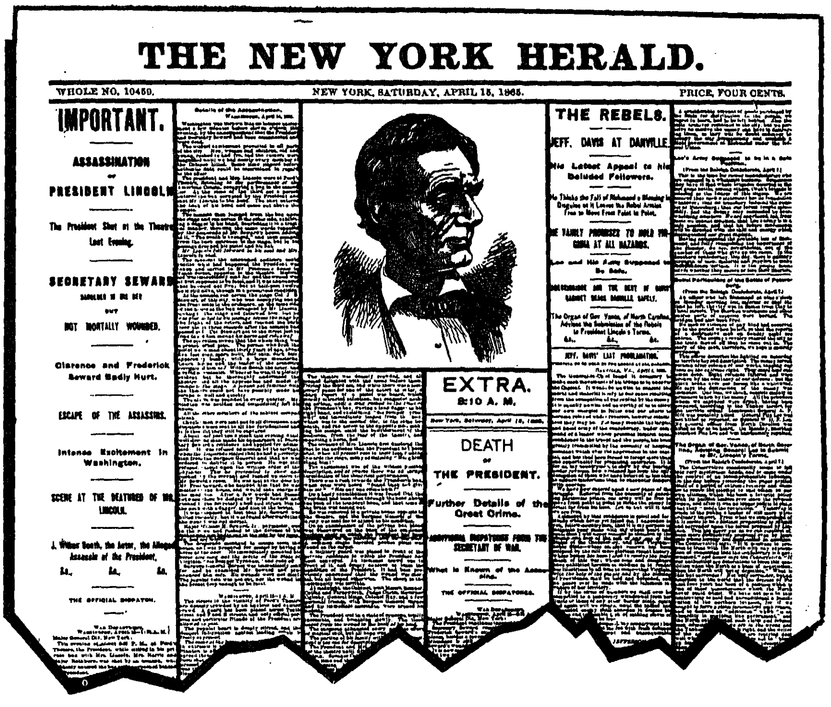
Screens made from silk cloth and wire mesh, and negatives made from ruled and checkerboard ink drawings had all been tried without success before Levy introduced a diamond-ruled, cross-lined sealed screen.

The glass halftone screen broke a photograph into a series of small dots. When printed, these dots blended together to give the appearance of continuous tone. Photographs were then produced without the loss of tone values.

Today the Navy uses the contact screen—a type of halftone screen that has an acetate or plastic base—to produce the required negatives for the reproduction of tone copy.

MULTIPLE EXPOSURES

As you know, only one exposure (shot) is required to produce line negatives. Halftone negatives can also be made with one exposure; however, the negative will be flat (without contrast). Camera operators have found that they can get better contrast when they divide the total exposure time into a series of two or more exposures. Each exposure should be made with a different lens aperture opening to bring out the detail,



THE NEW YORK HERALD.

WHOLE NO. 10460. NEW YORK, SATURDAY, APRIL 15, 1865. PRICE, FOUR CENTS.

IMPORTANT.

ASSASSINATION

OF

PRESIDENT LINCOL

The President Shot at the Theatre Last Evening.

SECRETARY SEWARD

BUT

NOT MORTALLY WOUNDED.

Clarence and Frederick Seward Badly Hurt.

ESCAPE OF THE ASSASSINS.

Intense Excitement in Washington.

SCENE AT THE DEATHBED OF MR. LINCOLN.

J. Wilkes Booth, the Actor, the Alleged Assassin of the President,

&c., &c., &c.

THE OFFICIAL DISPATCH.

Details of the Assassination.

EXTRA.

8:10 A. M.

New York, Saturday, April 15, 1865.

DEATH

OF

THE PRESIDENT.

Further Details of the Great Crime.

ADDITIONAL DISPATCHES FROM THE SECRETARY OF WAR.

What is Known of the Assassins.

THE OFFICIAL DISPATCHES.

THE REBELS.

JEFF. DAVIS AT DANVILLE.

His Latest Appeal to his Deluded Followers.

He Thinks the Fall of Richmond a Blessing in Disguise as it Leaves the Rebel Armies Free to Move From Point to Point.

HE VAINLY PROMISES TO HOLD VIRGINIA AT ALL HAZARDS.

Lee and His Army Supposed to be Safe.

The Organ of Gov. Vance, of North Carolina, Advises the Submission of the Rebels to President Lincoln's Terms.

&c., &c., &c.

JEFF. DAVIS' LAST PROCLAMATION.

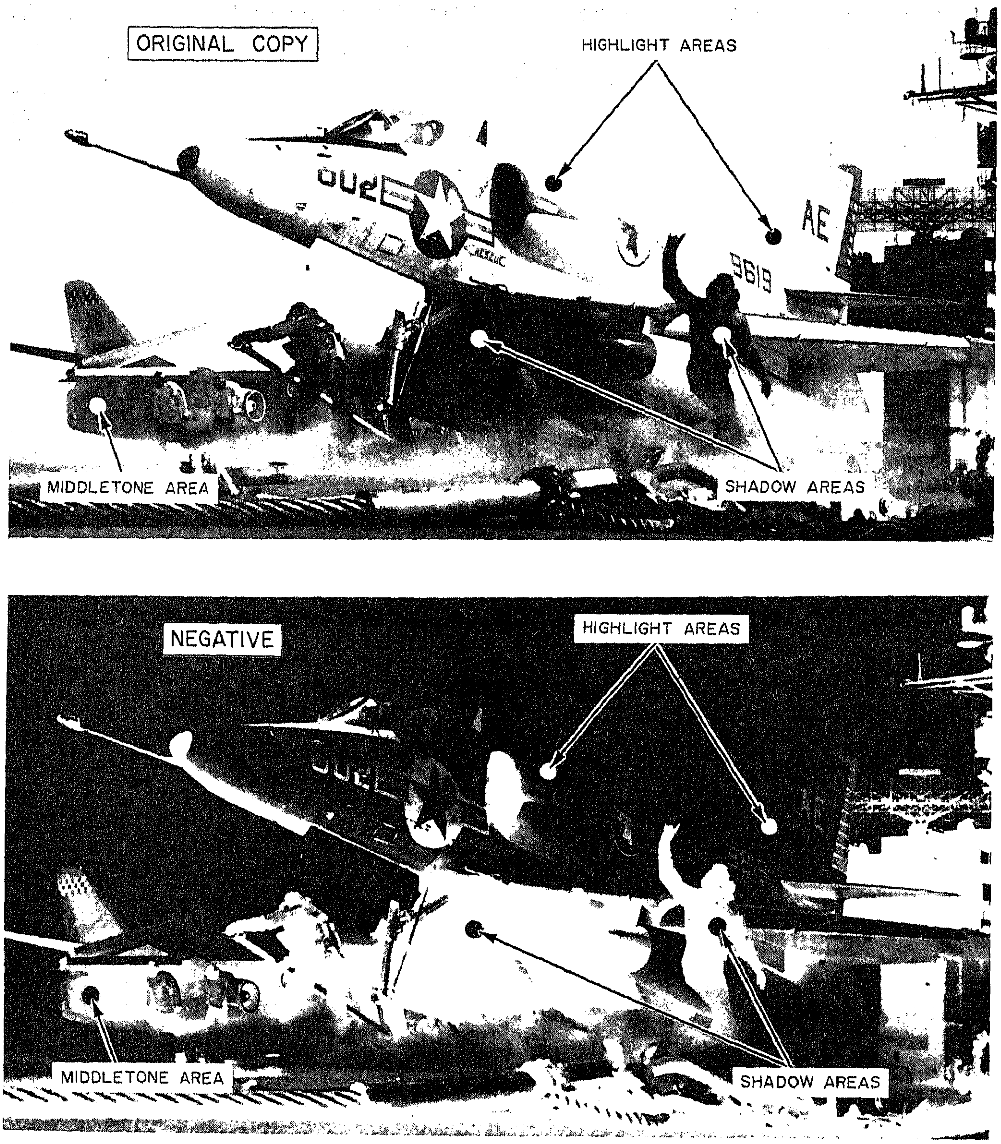
57.118

Figure 8-1.—Line art work in print.

middletones, and highlights of the copy. Figure 8-2 shows the results of these different exposures. One exposure brings out the detail of the copy; one brings out the middletones; and the other shows the highlights. If sufficient contrast control can be obtained with the other exposures, the middletone exposure is usually omitted. In addition to a regular exposure, a supplementary exposure called a flash is usually included to introduce a fine pinpoint dot in the shadow areas.

HALFTONE NEGATIVES LENS OPENINGS

The f/45 lens opening (stop) is generally used as a basic for the detail exposure. (The f/45 stop is used if the copy is to be shot same-size. However, if the copy is to be enlarged or reduced, a corresponding value of this opening is used. For example, if the copy is to be enlarged three times, f/22 is used instead of the f/45 stop.)



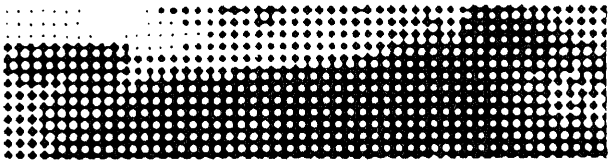
57.719

Figure 8-2.—As you see here, the highlights are the whitest areas of the original copy and the blackest areas on the negative. The shadows are the darkest areas of the original copy and are almost transparent on the negative. The middletones

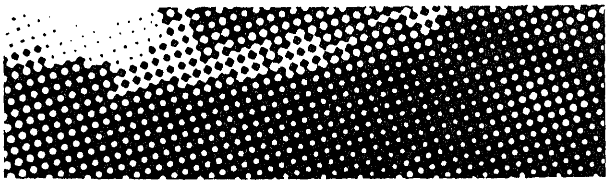
If the detail (main) exposure were used alone, the negative would be flat. To improve contrast (snap it up), the camera operator should change the lens aperture opening and then make a second exposure for highlight on the same piece of film. The f/22 stop is generally used as a basis for the highlight exposure. This exposure, given to record the bright areas of the copy, is usually of very short duration, requiring about one-fourth as much time as the detail exposure. Because a larger aperture opening is used for the highlight exposure, more light is admitted to the camera, and this produces a larger dot on the film. But because the highlight exposure is so short, only the light from the brightest highlight areas of the copy has time to register on the film. The gray and shadow areas of the copy reflect less light than the highlights, so the light from these areas does not have time to penetrate the film emulsion. Therefore, the highlight dots spread and grow until only a small, transparent opening is left between them, but there is little change in the size or opacity of the shadow and middletone dots. (See fig. 8-3.)

These two exposures take care of the detail and highlight areas; but as you can see in figure 8-3, the shadow areas are still underexposed, having weak, transparent dots in some areas and no dots at all in other areas. If such a negative were printed on a plate, the shadow areas would tend to fill in solid, and most of the shadow detail would be lost.

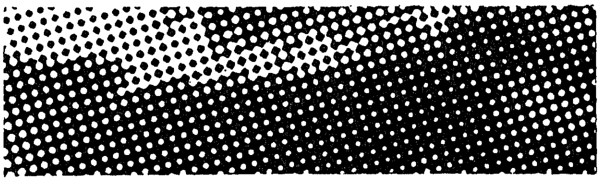
So, the camera operator uses a flash exposure to increase the density of those dots in the shadow areas and/or provide dots where none exist. A small aperture opening (generally f/90) is used as a basis for the flash exposure, and this exposure is of short duration—about the same length of



DETAIL EXPOSURE. NOTICE THAT HIGHLIGHT DOTS ARE SMALL AND THAT DOTS IN SHADOW AREAS ARE WEAK OR MISSING.



HIGHLIGHT EXPOSURE INCREASES SIZES OF HIGHLIGHT DOTS, BUT HAS LITTLE EFFECT ON DOTS IN SHADOW AREAS.



FLASH EXPOSURE BUILDS UP DOTS IN SHADOW AREAS, BUT DOES NOT AFFECT SIZE OF DETAIL OR HIGHLIGHT DOTS.

time as the highlight exposure. Two methods of supplying light to the film are recommended for a flash exposure:

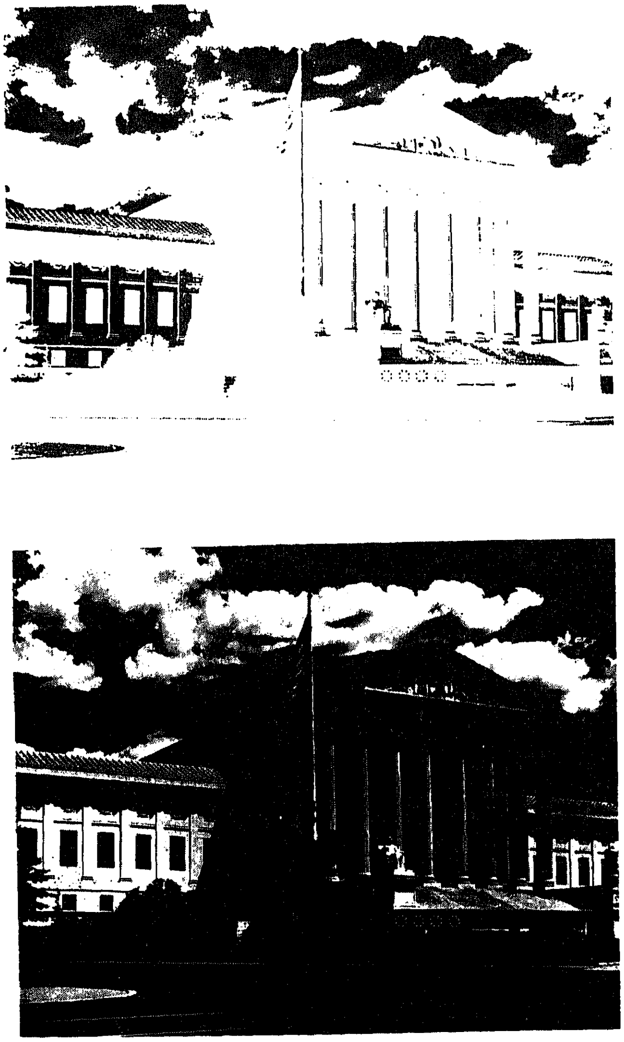
1. Place a white sheet of paper on the glass of the copyboard over the copy before making your flash exposure.
2. Shine a yellow-filtered safelight uniformly on the film through the screen from a distance of 5 to 6 feet after opening the camera back.

Because the lens aperture opening is so small and the exposure time is so short, the flash produces a very small, opaque dot. This opaque dot provides a dense, hard core to all the dots on the negative. Because the core is so small, it does not alter their size but increases their opacity in the center. (See fig. 8-3.) Flashing preserves detail in the shadow areas by building up the opacity of the dots so they will not be lost when the negative is printed on the offset press plate.

Multiple exposures may be made in any order and in any combination of exposure times (see figs. 8-4, 8-5, and 8-6).

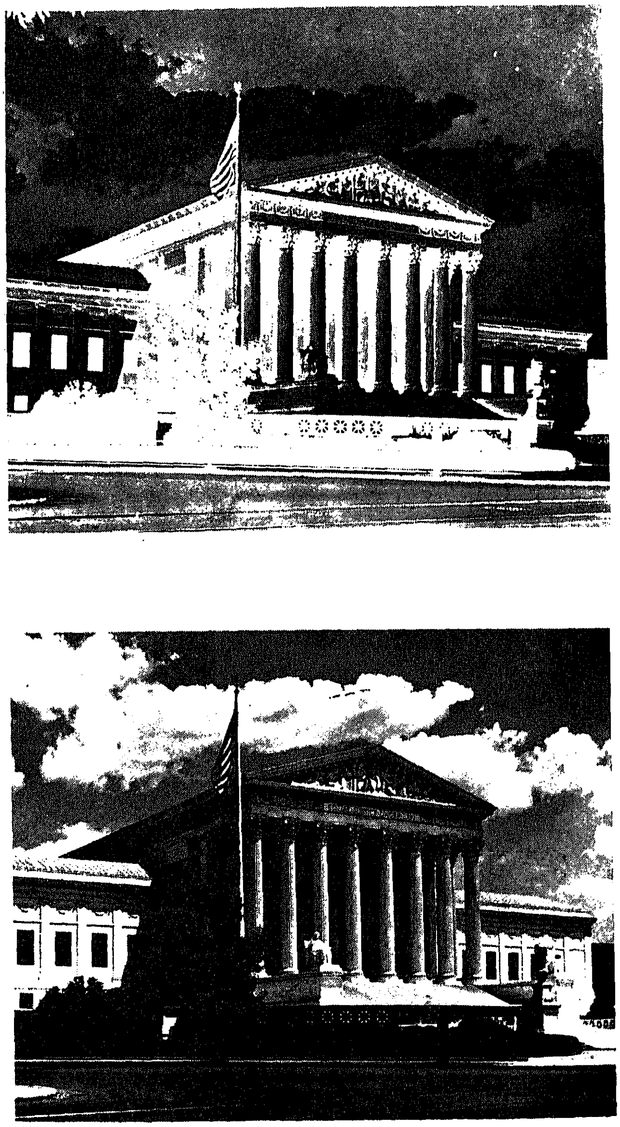
EXPOSURE TIME

The exposure time varies with the type of lighting, the speed of the film, and other shop



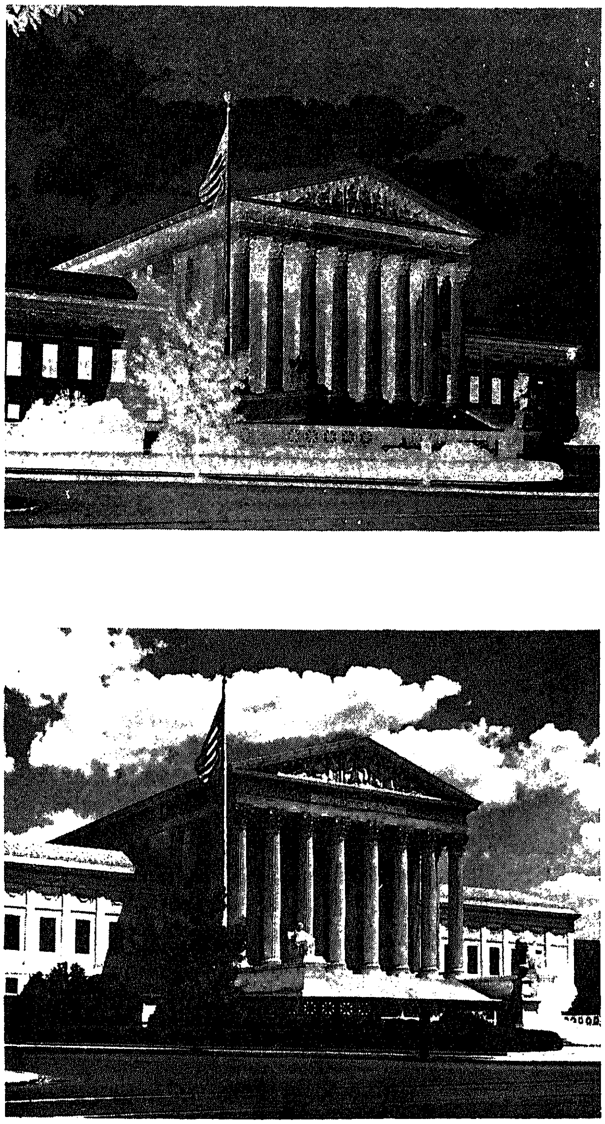
113.75X

Figure 8-4.—Above, negative made with highlight exposure only. Below, proof from plate made with negative.



113.76X

Figure 8-5.—Above, negative made with detail and highlight exposures. Below, proof from plate made with negative.



113.77X

Figure 8-6.—Above, negative made with detail, highlight, and flash exposures. Below, proof from plate made with negative.

conditions. For this reason, camera operators must determine the correct exposure time experimentally at first, just as they do in making a line negative. Once the exposure time has been established, it remains fairly constant for all ratios of enlargements or reductions which follow.

CONTACT SCREENS

The contact screen has a safety film base of either acetate or plastic and was produced photographically. The contact screen gets its name from being used in direct contact (emulsion to emulsion) with the film when the exposure is made. (See fig. 8-7.) You can identify the emulsion side of the screen by holding the screen up and looking at the printing along its edge. If the printing is readable left to right, the emulsion side is facing you. Contact screens are available in standard rulings of 50 to 400 dots (or lines) per linear inch. The finer rulings enable the camera operator to produce better detail than is possible with the coarser screens. Contact screens also produce a better rendition of tone from the copy because the dots take the form of the subject detail and thus create a smoother optical illusion.

HANDLING OF SCREENS

Contact screens are not extremely fragile; however, they should be handled and stored with care. They are easily marred by waterspots or fingerprints. Also the screens can be scratched or embossed by the edges or corners of the film. They also fade or lose their color with time and prolonged use, and this changes their reproduction characteristics. Also, contact screens are expensive and are not easily replaced.

Fingerprints, waterspots, scratches, and dust will affect the dot formation of contact screens, so you should handle the screen by its edges, and you should keep it in its container when it is not in use. You can clean the screen with a commercial

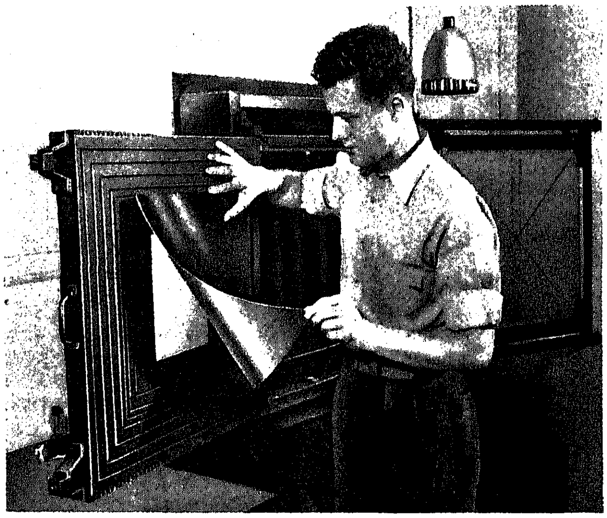


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Figure 8-7.—The contact screen is used in direct contact (emulsion to emulsion) with the film.

film cleaner. If dirt is stubborn, immerse the screen in plain water at room temperature or in a solution consisting of 4 ounces of alcohol, 1 capful of Photo-Flo, and 1 gallon of water. (If you clean the screen with plain water, treat it with a wetting agent, such as Photo-Flo, before hanging it up to dry.) Go over the screen lightly with a piece of cotton saturated with the solution to wipe away the stubborn spots. Do not allow the screen to soak longer than 5 minutes, because the dye might dissolve and cause streaks if you do. If some of the dye is removed by cleaning, the screen's filtering factor will be altered and its performance affected.

Never use a camel's hair brush on a contact screen. You can dust the screen by wiping it lightly with a piece of photo chamois or by going over it with a static-removing brush, which is designed to remove dust particles and eliminate static. If you do not have such a brush, tap the edge of the screen lightly against a table top before using it. This will disperse static and eliminate dust particles.

Perhaps the worst screen problem for the camera operator is the half-mooned creases that occur when a wrinkle is snapped into the screen when it is picked up. To prevent these half-moons from forming in the screen, you should handle the screen carefully and raise the sides from the diagonal corners to form a kind of roll in the middle as you pick it up.

Before handling contact screens, you should be sure that your hands are clean and free from all chemicals. All photographic processing chemicals are harmful to screens, particularly hypo—it can ruin a contact screen in less than a day.

PURPOSE OF SCREENS

Different types of contact screens are sold by a number of companies. The most popular types of contact halftone screens are the magenta halftone screen and the gray contact screen. The magenta contact screen is used most often for black-and-white halftone work. The gray contact screen, on the other hand, is used not only for black-and-white work but also for producing negatives from colored copy.

Each of these contact screens is designed for a specific purpose and will perform best when used for that purpose. The magenta contact screen is produced as a *negative* and also as a *positive* contact screen. The negative magenta contact screen is used to produce halftone negatives, and the positive magenta contact screen is used for producing halftone positives for continuous-tone negatives. Of course, you can make a good halftone negative with a positive screen if you use an additional highlighting (or bump) exposure (an exposure without the screen in place). Because the negative screen increases contrast, you can generally eliminate the bump exposure when you use the negative screen for shooting negatives. You will lose contrast if you make positives with a negative screen.

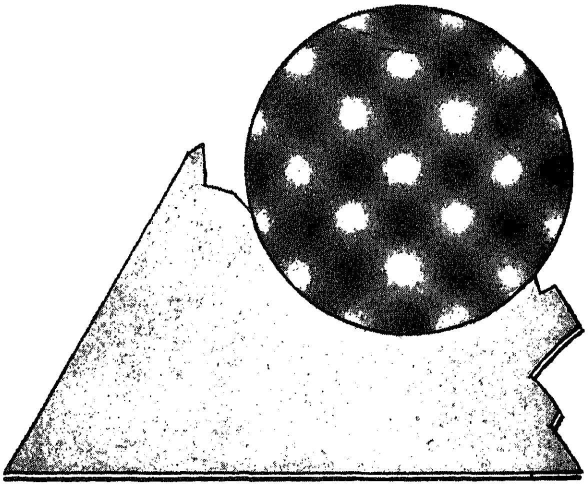
CHARACTERISTICS OF SCREENS

The magenta screens cannot be used for copying colored originals because of the filtering factor of their color. However, the gray screens have a built-in bump exposure and can be used for either color or black-and-white work.

In addition to the conventional screens just discussed, there are also elliptical (chain dot) gray contact screens, round dot screens, and Respi double dot screens that are available in either gray or magenta. There are also special-effect screens that come in stippled, circle, wavy line, and other patterns. These screens will be discussed later in this chapter.

MAGENTA CONTACT SCREEN

Most of your work will be done with the negative magenta screen. This screen is a negative made up of vignetted dots in which the gray, silver image is replaced by a dye-coupled magenta image. The size of the dots on the negative is controlled by the amount of light passed by the different zones of each vignetted opening in the screen. (See fig. 8-8 .) Because the magenta-dyed



57.141

Figure 8-8.—Section of a vignetted-dot contact screen.

vignetted dots are more transparent to some colors of light than to others, filters can be used as a factor in contrast control.

Normal-contrast copy is generally photographed without a filter; however, if the copy is extremely contrasty, it is possible to shoot it through a yellow (Wratten No. 4) filter to make the highlights and shadows grayer and reduce the overall contrast. The magenta filter (Wratten No. 30) may be used if the copy is extremely flat (lacking contrast). When copy is photographed through a magenta filter, the dots in the highlights approach solid white in the final print.

SCREEN POSITION

Contact screens can be used only on process cameras equipped with a vacuum back. The screen should be larger than the film so that it will extend beyond the edges of the film and over the vacuum channels on the camera back. If the screen is not large enough to do this, you may add strips of clear film or acetate along the margins, carefully joining them to the screen with pressure-sensitive tape so that no wrinkles are formed. (Some camera operators tape the screen under a window cut in the center of a sheet of acetate. The acetate then acts as a frame, protecting the edges of the screen.) The screen must be placed over the film, emulsion to emulsion. When a number of exposures are to be made with the same screen, you can reduce handling by fastening the top of the screen to the vacuum back with a strip of masking tape. The sheets of film can then be inserted under the screen as subsequent exposures are made. Some camera operators use a clean, soft, rubber roller to roll over the screen surface to ensure even contact with the film, eliminating wrinkles in the screen. You may also remove wrinkles by placing a piece of paper over the screen and rubbing the paper with your hand. It is not a good idea to rub the screen directly with your hand; you might scratch the screen, contaminate the screen with oils from your hand, or charge it with static electricity which will cause the screen to pick up dust.

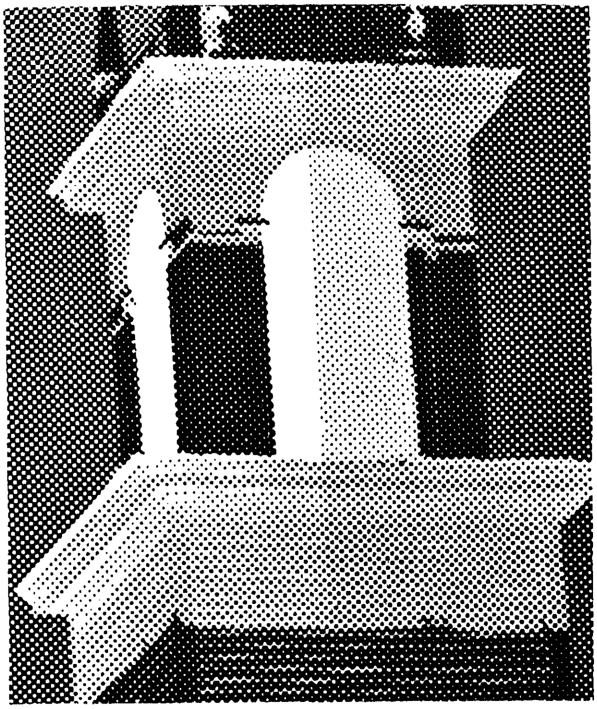
MAGENTA CONTACT SCREEN LENS OPENINGS

The dot formation is not controlled by the size of the lens aperture opening when the contact screen is used. The f/16 opening is generally used for same-size shots, but you can use any aperture opening down to f/32 with equally satisfactory results. Of course, when enlargements or reductions are made, you must change the aperture opening to compensate for the difference in camera extension.

MAKING THE EXPOSURE

You have already seen that filters or a highlight (bump) exposure can be used to control contrast on a magenta screen. You can also control contrast to some degree by varying the period of agitation when the film is being developed. However, most copy can be shot satisfactorily with a detail exposure made with white light (without a filter) and a flash exposure made to yellow light. Yellow light is used for the flash because it produces the smallest and hardest dot formation possible on the film.

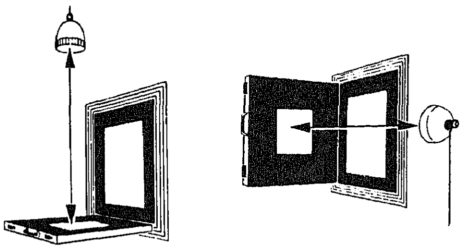
To make your main exposure, you simply set the lens for the required aperture and then make an exposure without a filter for the required length of time. (See fig. 8-9.) After this, open your



Reproduced with permission from the Kodak publication *How to Use the Kodak Magenta Contact Screen*, c. Eastman Kodak Co., 1960.

57.143X

Figure 8-9.—Enlarged section of negative showing how flashing brings out the detail in the shadow areas. Right side received flash; left side did not.



Reproduced with permission from the Kodak publication *How to Use the Kodak Magenta Contact Screen*, c. Eastman Kodak Co., 1960.

57.145X

Figure 8-10.—Safelight used for the flash exposure may be mounted above the camera or to the side, depending on which way the camera back opens.

camera back and make your flash exposure by exposing the film through the screen directly to a darkroom lamp equipped with a Wratten series OO (yellow) or OA (yellow green) filter. If a series OO filter is used, you should use a 7 1/2-watt frosted bulb in the lamp, and the lamp should be placed 6 feet from the camera back. (See fig. 8-10.) If a series OA filter is used, you should have a 60-watt frosted bulb in the lamp, and the lamp should be placed approximately 6 feet from the camera back. Because the series OA filter does not transmit as much light as the series OO, it requires about twice as much exposure to produce the required shadow dot on the film. The light from the darkroom lamp must fall on all parts of the film equally. Since the exposure is of short duration, this exposure does not increase the size of the dots in the middletone and highlight areas. The flash exposure is generally made *after* the main exposure; however, the order in which the exposures are made can be reversed if desired.

Flash exposures can also be made with a custom made flash lamp. If the camera is equipped with such a lamp, the camera operator simply swings the lamp in front of the open lens so that the light will shine into the camera during the flash exposure. Some cameras have an internal flashing light. Here, the film receives the flash exposure from the internal light light while the main exposure is being made through the lens.

SCREEN RANGE

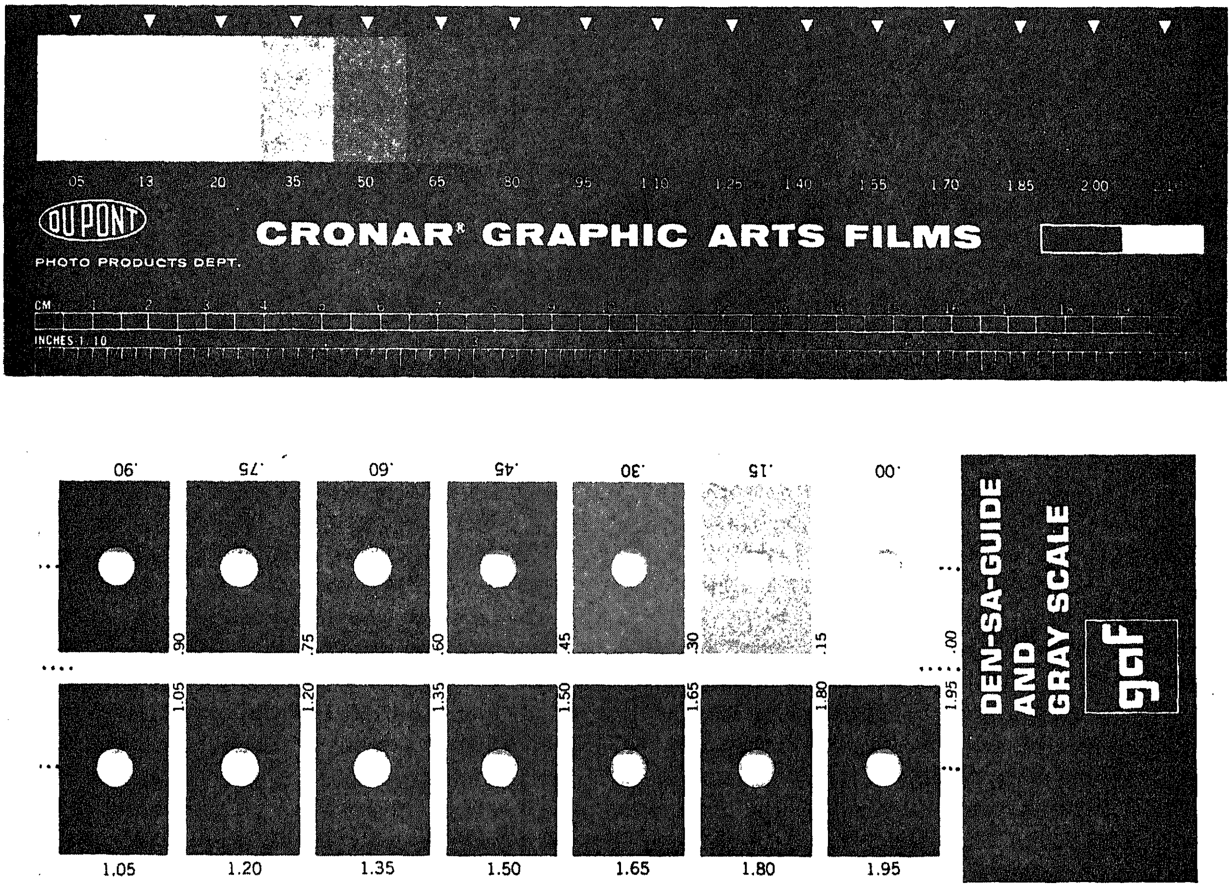
To make the correct exposures, you need to know the range of your contact screen. Some contact screens can produce a greater range of tone than others using the same camera setup. To determine the density range for your particular screen, you should use an f/16 opening and make a same-size halftone shot of a gray scale like those shown in figure 8-11. (You will notice that each step on the gray scale is marked with a number showing the approximate reflection density of the tone in that particular step. This marking is essentially the same as the reading you would get if you measured the tone with a reflection densitometer.)

Develop the negative in the regular manner and then examine the dot pattern in the exposed area. You will find that no dots have been formed in some steps of the gray scale, such as the extreme shadow areas. Locate on the negative the step that has a 90 percent highlight dot and the step that has a 10 percent shadow dot and read the densities below these steps. (See fig. 8-11.) If the 90 percent step has a density reading of 0.05 and the step containing the 10 percent shadow dot has a reading of 1.10, subtract the 0.05 from the 1.10, and you will have 1.05 as the density range of your screen.

As you can see in figure 8-12, a 90 percent highlight dot is almost solid black when the negative is developed. The black dots are so large they overlap or run together, and only a small, transparent opening is left between them. The black dots cover 90 percent of the film, and the transparent openings between them comprise the other 10 percent. (The openings of the highlight area print as tiny black solids, and the remainder of the area is white open space.) In the shadow areas, the camera operator strives for just the opposite. In this case, a 10 percent black dot (a small pinpoint dot) will cover only 10 percent of the shadow area and the remaining 90 percent of the area will be transparent. The open space will then print almost solid in the shadow area of the finished product.

The 10 percent dot-to-90 percent dot ratio is used because it produces a balanced negative; however, this ratio is not used in all cases. Many of the larger commercial shops use a 95 percent dot in the highlights and a 5 percent dot in the shadows. This ratio is ideal because it provides the smallest printable dots when the job is run. However, if you do not have a densitometer, you will find that a good standard is to use the 10 percent-to-90 percent ratio as a basis for your work because it is difficult to judge accurately a 5 percent dot visually.

The plate and press characteristics must also be considered in figuring the required exposures used in conjunction with your screen range. If you



57.183

Figure 8-11.—Gray scales. If you punch a hole in each step of the scale, you can use it in determining the density range of your copy. To use it for this purpose, move it over a selected highlight or shadow area until the area of the copy visible through the punched hole matches one of the steps on the scale.

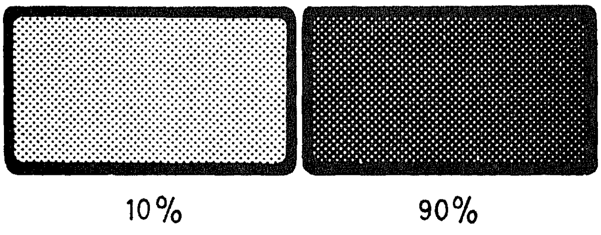


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Figure 8-12.—Enlarged sections of a negative showing a 90 percent highlight dot and a 10 percent shadow dot.

have a 95 percent highlight dot on your negative, you expect a 5 percent black dot to print in the highlight area when the job is run on the press. However, the printing pressure and the ink may increase the size of the dot and print a 10 percent black dot in the highlight areas on the press sheet. Similarly, a 5 percent shadow dot may fill in and be lost completely when run on some presses. For this reason, you should prepare a test halftone plate and run it on each of your presses to see what size of dot reproduces best under the conditions in your particular shop. There is no reason to shoot halftones for a 5 percent shadow dot if the press will not reproduce (hold) them. The paper stock may also affect the dot range. You can reproduce a finer dot if you use a coated (glossy) paper stock to print on rather than a soft, porous paper. Some camera operators use a 20 or 25 percent (basketball) dot in the shadow areas when printing on newsprint or similar porous stocks.

Study figure 8-13 to better understand how to interpret the results of your screen range density test exposures.

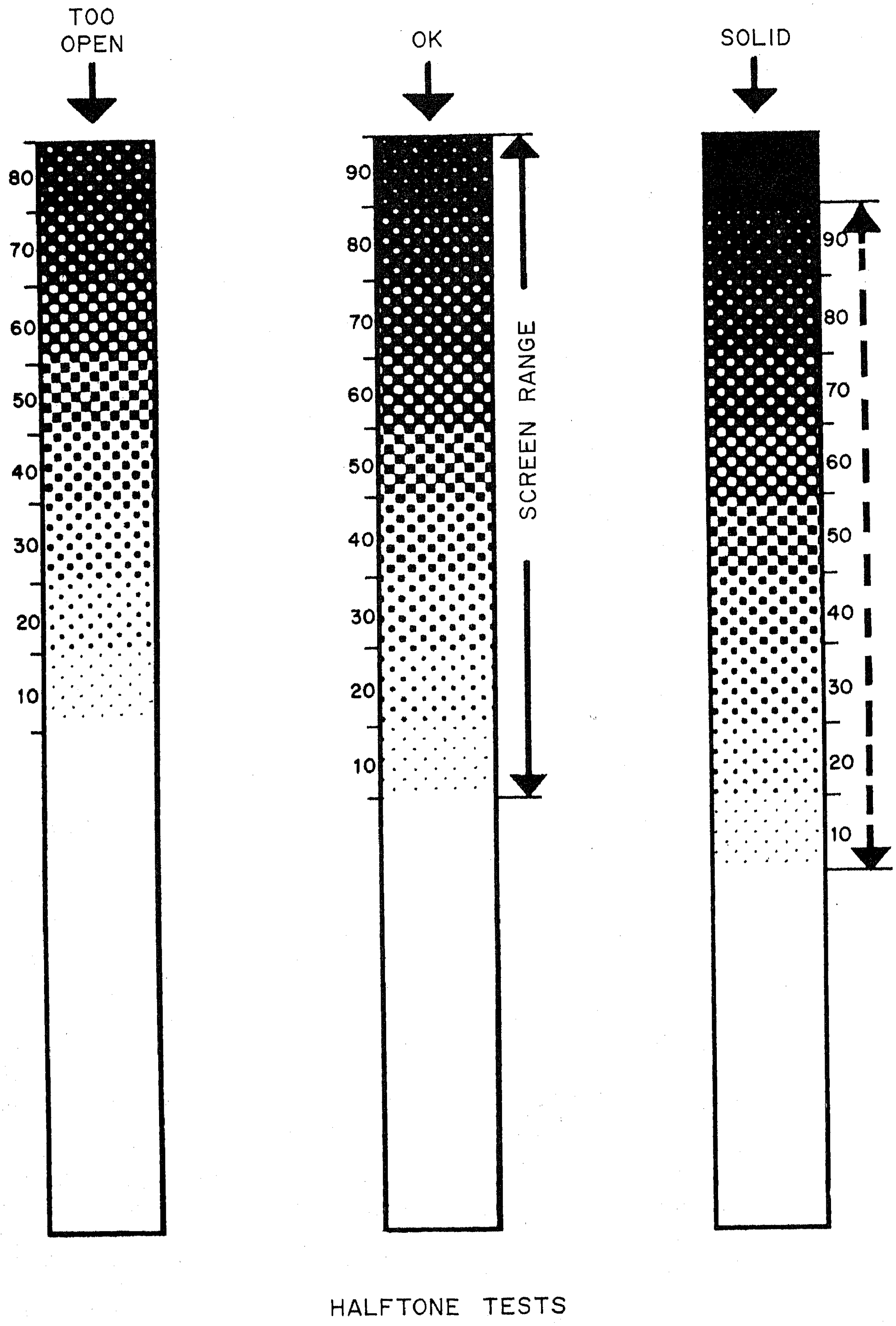

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Figure 8-13.—Examples of halftone test steps used in determining screen range density test exposures.

To determine the basic density range (BDR) of your screen, you should make a same-size white-light exposure of a gray scale. Try to time your exposure, at f/16, so the negative will have a 90 percent dot in step *one* (the step with a density reading of 0.00) of the scale. If step one contains a smaller dot, you cannot determine the screen range and will have to make another negative. However, if you have a 90 percent dot in step one, two, or beyond, you can determine the screen range satisfactorily even though step one is filled in and becomes solid black. (Some camera operators prefer to fill in (plug up) step one and have the 90 percent dot appear in the second step so they can see where the printable dot first appears.) When you shoot a gray scale with a single exposure, you will find when you develop the negative that the screen has produced dots in a certain number of steps on the scale. The number may vary from one screen to another, depending on the manufacturing process, type of film used, camera and darkroom conditions, and method of development used. Now study the center example shown in figure 8-13. Notice that there is a 90 percent dot in step *one* and that there are progressively smaller dots in the other steps through step *nine*. If you *increase* your exposure, the highlight dot will fill in and go solid black in step one and the 90 percent dot will be produced in step *two*, as shown in the example on the right in the same figure. The dot size will shift in the other steps too, and you will now have the smallest dot in step *ten* of the gray scale. You still have only nine steps because step one has gone solid black. *Decreasing* your exposure will shift the dots in the other direction, as shown in the example on the left in the figure. But as you can see, the decreased exposure will reduce the number of steps with dots. Since this example has no 90 percent dot, it is not usable in determining BDR. From this test you will find that this particular screen can produce a basic density range of only nine steps of the gray scale with a single exposure. Changing the exposure time will move the dots up or down but will never add more steps.

If you make a halftone using only one exposure, you will usually lose some of your shadow detail because of screen range limitations. However, you can use an additional exposure (flash) to extend the screen range in the shadows. When the flash is used, the screen will produce dots in steps ten and beyond; and the longer the flash exposure (up to a point), the greater the number of additional steps it will cover. The flash exposure affects only the shadow end of the scale; it should not be so long that the flash affects the middletones.

DENSITY RANGE OF COPY

To determine the required exposure, you must know the density range of your copy as well as the density range of your screen. Once you have established the density range of your screen, it will not change; but the density range of the copy might vary from one piece to the next.

To find the density range of your copy, subtract the density reading of the highlights from that of the shadows. To do this, select the darkest shadow area in which detail is visible and the brightest highlight containing detail. You can disregard catchlights (negligible highlight areas in which it is unnecessary to hold detail, as in the highlights of the eyes in photographs of people). If all the copy is dark, as in the case of a night scene, use the white margin or border of your copy for the highlight reading. Once you have selected your highlight and shadow areas, move a gray scale over the copy until the steps on the gray scale match the selected highlight and shadow areas of the copy. (For easier comparison, some gray scales have a hole punched in the center of each step. If your gray scale does not have such holes, you should punch a hole in each step.) When the selected area matches one of the steps on the gray scale, note the density reading for that step. Find the density reading for the selected highlight area and then for the selected shadow area and subtract the highlight reading from that of the shadow. This will give you the density range of the copy. (Although density range varies from one piece of copy to another, experience has shown that the average density range for copy of normal contrast is 1.60.)

If the density range of the copy is the *same* as that of the screen, you can reproduce the copy satisfactorily with a single exposure and no flash. If it is *less* than that of the screen, as might be the case with flat copy, you should use a bump (no screen) exposure to increase the contrast. (This is known as compressing the screen range.) If the density range of the copy is *greater* than that of the screen, you must use a flash to lengthen the effective density range of the screen. The difference between the density range of the copy and that of the screen is known as the excess density. For example, if the density range of the copy is 1.60 and that of the screen is 1.05, you subtract the 1.05 from the 1.60 and you will have 0.55 as the excess density. As you will see later, it is necessary to know the excess density for each piece of copy in order to determine the length of time for your flash exposure.

HALFTONE EXPOSURES

Exposure times vary with the type of copy, type of lighting, type of screen, type of flashing lamp, type of film, and method of processing the film. To determine exposure time, you must first establish a basic time for both the main and flash exposures for your particular camera setup. This basic exposure is then your starting point. You can vary it as necessary according to the type of contrast in each piece of copy.

Manual or automatic exposure computers can be used to determine the exposure times for individual pieces of copy once the basic exposures have been established. When an exposure computer is not available, you can use the following method for determining your exposures.

BASIC MAIN EXPOSURE

To determine your basic main exposure, you should make a same-size white-light exposure of a gray scale, using an f/16 aperture opening and using the film and processing chemicals you will ordinarily be using in your work. Your basic main exposure time will be the exposure time required to put a 90 percent highlight dot in step one on the gray scale. This exposure will vary with your camera setup, but it is normally four to seven times as long as a line copy exposure. (Due to the characteristics of screens, exposure time varies from one screen to another. A magenta screen usually requires more exposure than a gray screen, and a 133-line magenta screen may require more exposure time than a 120-line magenta screen. Exposure time may also vary between two magenta screens of the same screen ruling because of the color variation between the two screens.)

You must determine the actual exposure time experimentally. If examination of the first

1 HIGHLIGHT DENSITY	2 EXPOSURE FACTOR	3 MAIN EXPOSURE TIME (SECONDS)
0.00	1.00	18
0.05	1.12	20
0.10	1.26	23
0.13	1.35	24
0.15	1.41	25
0.20	1.58	28
0.25	1.78	33
0.30	2.00	36
0.35	2.24	40
0.40	2.50	45
0.45	2.82	50
0.50	3.16	56

57.712

Figure 8-14.—Basic main exposure table. The exposure times listed in column 3 are included for the purpose of illustrating how the system works. In actual practice you should make a test negative and use the information from it to insert your own set of figures in this column.

developed negative shows that the dots in step one are larger than 90 percent, you should make another negative, reducing your exposure time slightly. However, if the dots are smaller and the openings between them are larger, you should make another negative, increasing your exposure time slightly. After you have made a negative with a 90 percent dot in step one of the gray scale, you can prepare a table, like the one shown in figure 8-14. In column 1 of the table, list the numbers (density readings) shown under each step on your gray scale. In column 2 write in the exposure factors *as listed* in the illustration. (These factors are fixed and will not change.) In column 3, list the exposure time required to put a 90 percent dot in each of the density steps listed in column 1. (This will be basic main exposure time.) To find the exposure times for column 3, multiply your basic main exposure time by the exposure factor listed for each of the density steps shown in column 1 and then divide by 1.00 (the factor for the 0.00 density step). For example, if it took 18 seconds to produce a 90 percent highlight dot in step one (the step having a highlight density of 0.00), you should write the 18 seconds in column 3 on the same line as the 0.00 density. Once this has been done, you can find the exposure required to put a 90 percent dot in the density step marked 0.05 by multiplying the 18 seconds (basic exposure time) by 1.12 (the exposure factor for the 0.05 density step). Then divide by 1.00 (the exposure factor for the 0.00 density step).

18 seconds × 1.12 = 20.16 or 20 seconds

20 ÷ 1.00 = 20 seconds

Write this 20 seconds on the table in column 3 on the line marked 0.05 in column 1. You can then find the exposure time required to produce the 90 percent dot in the step marked 0.10 by multiplying the 18 seconds by 1.26 and dividing by 1.00, and so on. Continue until all the blanks in column 3 are filled in.

Let's assume that the lightest step on your gray scale compares to the step marked 0.05 in density rather than 0.00 and that it takes a 20-second exposure to put a 90 percent dot in this step. In this case, you should record the 20 seconds in column 3 of the table on the same line as the 0.05 in column 1. Once this has been done, you can proceed to fill in the other exposure times in column 3. Let's say, for example, that you want to reproduce your 90 percent dot in the step marked 0.13 instead of the one marked 0.05. In this case, first multiply your known exposure (20 seconds) by the exposure factor (1.35) opposite the 0.13 on the table. Then divide by the exposure factor (1.12) listed opposite the 0.05 (the original highlight density).

20 seconds × 1.35 = 27 seconds

27 ÷ 1.12 = 24.1 or 24 seconds

(This means that you should increase your main exposure to 24 seconds when the highlights of your copy are gray and the brightest area matches the gray scale step marked 0.13.)

This method will determine the exposure for all the other steps on your gray scale; and once they have been found, you should list them in column 3 of the table.

(Exposure time will vary with enlargements and reductions, of course, and it will also vary if you use an aperture other than f/16.)

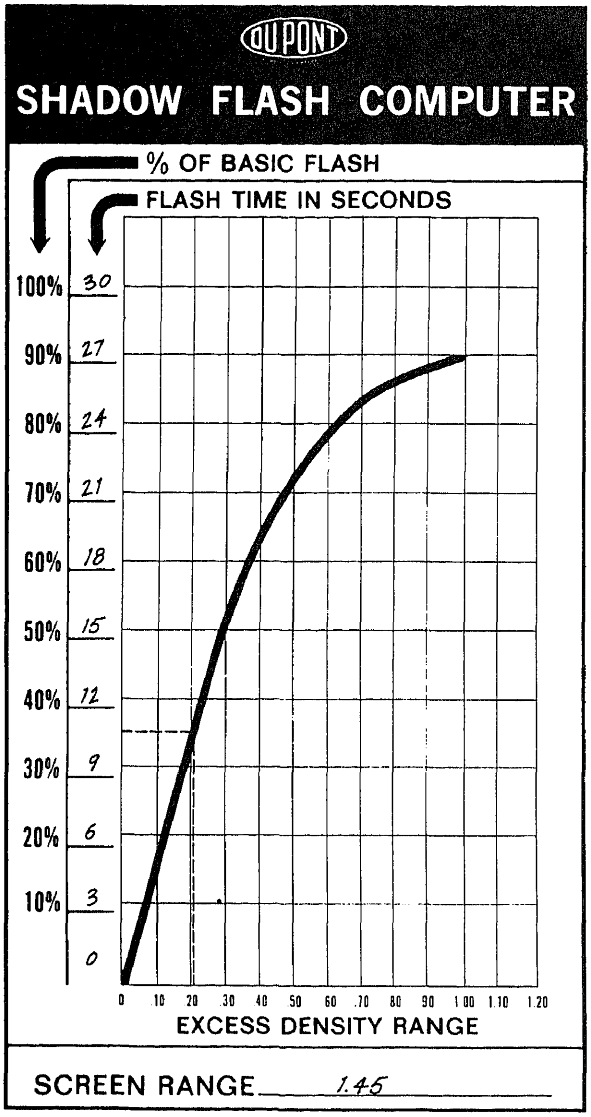
BASIC FLASH EXPOSURE

You will also have to determine your basic flash exposure experimentally. The basic flash exposure is the time required to produce a 10 percent black dot when a flash (but no main exposure) is given to the film.

To determine your basic flash exposure, open the camera back and make a series of stepped exposures through the screen, ranging from 10 to 60 seconds in length with 5-or 10-second intervals between them. After developing the film, check the steps to find out which one gives you the desired 10 percent shadow dot. The time required for producing this step will be your basic flash exposure, and it will not change as long as you continue to use that particular type of film and camera setup.

Once you have determined your basic flash exposure, you can use it in computing your actual flash for each job. Your basic flash exposure is the longest flash time that will ever be required. Of course, the flash you actually use when photographing copy will vary from one type of copy to another, because the film acquires a partial (threshold) exposure from the copy itself when the main exposure is made, and this reduces the amount of time required for the flash. So if your basic exposure time is 20 seconds, only 50 percent of the basic exposure, or 10 seconds, may be required to put a 10 percent dot on the film.

You can compute the actual flash exposure time for each piece of copy by using a chart like that shown in figure 8-15, once you know the basic flash exposure and the excess density range. If your basic flash exposure is 30 seconds, write that figure at the top of the second column, on the same line as the 100 percent mark. Next, compute the flash time in seconds for the other steps in the second column by multiplying the 30 seconds by the percentage figure listed for each step in the first column. For example, if 30 seconds is required to produce the 100 percent basic flash (30 × 1.00 = 30), then 27 seconds will be required for producing 90 percent of the basic flash (30 × .90 = 27), and 24 seconds will be required for producing 80 percent of the basic flash (30 × .80 = 24). Continue until all the figures have been filled in for the second column. You are then ready to use the chart for determining your flash exposures.



57.722X

Figure 8-15.—DuPont Shadow Flash Computer. Can be used in determining the flash exposures required for various excess densities. You will notice that the curve flattens at the top. Flash exposures greater than 90 percent of the basic flash exposure tend to create shadow dots which are all the same size, and this flattens the negative and causes loss of detail. The figures in the second column are determined by the basic flash exposure time your own tests show to be correct. For example, if your basic flash exposure was 40 seconds instead of 30, you would write in 40 opposite the 100% on the chart, and so on.

To use the chart, you must know the density range of your halftone screen. Let's say in this case that it is 1.45. Next, determine the density range of the copy to be shot. Let's say that it is 1.66.

Subtract the density range of the screen from that of the copy and you will have .21, which is the excess density range. Locate .21 on the base line of the chart and draw a perpendicular line from it up to intersect the curve, as shown in the figure. At this point, draw a horizontal line to the left edge of the chart. You will notice that the horizontal line intersects the line at the left edge of the chart at the 11-second position or 39 percent of the basic flash. This means that you should use an 11-second flash exposure for this particular piece of copy.

To simplify operations, you may set the chart up as a table like that shown below, showing the flash time required for the excess densities most commonly encountered. You can then refer to this table to find the proper flash time for copy having an excess density that falls within this range.

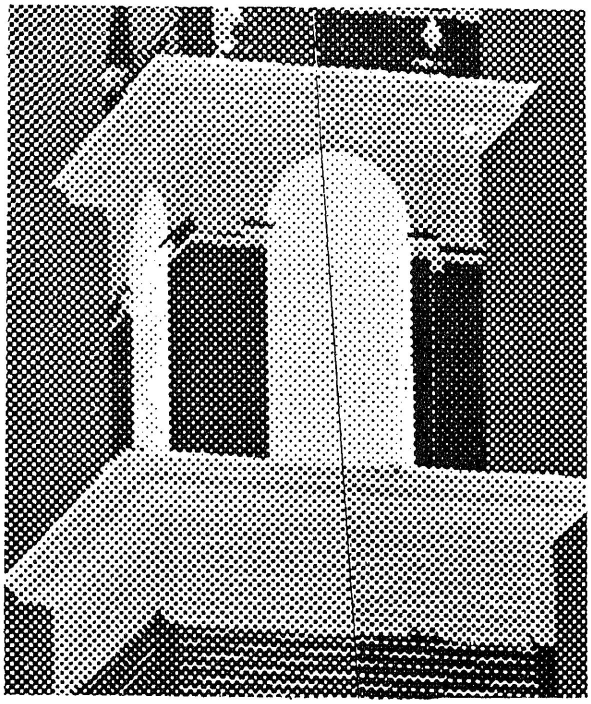
Excess Density	Flash Time
.05	
.10	
.15	
.20	
.25	
.30	
.35	
.40	
.45	
.50	

HIGHLIGHT (BUMP) EXPOSURE

The negative magenta contact screen improves the contrast of the copy and has the equivalent of a 7 percent bump exposure built into it. However, on rare occasions, the copy may be such that additional highlight separation is required and a bump exposure will improve the appearance of your finished product. (See fig. 8-16.) The bump exposure is given in addition to the main exposure. This bump exposure is essentially a line shot because the contact halftone screen is removed from the film before the bump exposure is made.

To make a bump exposure, place the film on the camera back, but do not position the screen over it until after you have made your exposure. Use a neutral density (ND) filter (Wratten No. 96, density 1.0) together with the lens, if such a filter is available. This filter transmits only 10 percent of the light and makes for easier control of your exposure. When you use this filter, you must increase your exposure ten times. For example, if the time for the bump is 2 seconds, increase the exposure to 20 seconds.

Sometimes camera operators use a 1.0 and a 0.3 ND filter together with the lens when giving the film a 5 percent bump exposure. If this arrangement is used, your bump exposure will be the same length of time as the main exposure, because these filters transmit only one-fifth (20 percent) of the light to the film.



Reproduced with permission from the Kodak publication *How to Use the Kodak Magenta Contact Screen*, c. Eastman Kodak Co., 1960.

57.144X

Figure 8-16.—Enlarged section of a negative showing how a bump exposure increases highlight contrast. Right side of negative received bump exposure; left side did not.

If you do not use a filter, you may be able to reduce the aperture setting on the lens by three full stops and increase your length of exposure eight times. This method may give you the same results as you would get when using a bump with a filter.

After you complete the bump exposure, open the camera back and position the screen over the film. Close the camera back and remove the neutral density filter or open the lens aperture and make the other exposures for their required length of time.

It is simpler to make your bump exposure first, followed by the main exposure and then the flash. However, if you prefer, you can make the bump exposure after the main exposure and the flash. Always take care not to move (disturb) the position of the film on the camera back until all the exposures have been made. Also, never change the position of the screen over the film between the exposures requiring it.

No bump exposure is needed if the density range of the copy is the same as or greater than the density range of your screen. If the density range of your copy is less than the density range of your screen, you can shoot copy without using a bump or flash exposure. In this case, the appearance of the finished printed halftone would be improved by using the bump exposure to extend the range of the halftone negative.

Suppose, for example, that the screen range is 1.05 and that your copy is flat and gray, having a highlight density of 0.05 and a shadow density of only 0.09. Here your copy range is only 0.85, which is less than the screen range of 1.05, and you can improve the appearance of the printed halftone by using a *shorter* main exposure than usual to darken the shadows and then giving a bump exposure to open the highlight areas.

If your shop has an exposure computer, it is a simple matter to calculate the length of time for the bump exposure. There are also methods for determining the length of the bump exposures mathematically, but they are rather complicated. If camera operators do not have an exposure computer, they usually estimate the length of the bump exposure.

The bump exposure may be 2 to 15 percent of the main exposure. However, since the bump exposure changes the size of the highlight dot, it should seldom be over 10 percent of the main exposure. The average bump exposure is 3 to 7 percent of the main exposure. Bump exposures greater than 15 percent of the main exposure could be used, but they might cause fogging of the highlight dot areas. (The length of the exposure depends on the type of light used as well as the density range of the copy.)

EFFECT OF THE BUMP EXPOSURE	
Percent of Main Exposure	Screen Compression
2	0.05
3	0.10
4	0.15
5	0.20
6	0.25
7	0.30

TONE CORRECTIONS

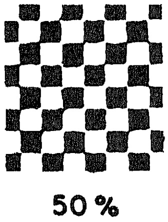
To reproduce both ends of the photographic scale accurately is difficult. You must shoot either for good highlight separation or for the shadow detail. When shooting for the highlight detail, you compress the screen range; when shooting for the shadow detail, you lengthen it. If the copy is contrasty, you can capture the detail and highlight portions with the main exposure, but you must flash the negative through the screen to provide shadow dots in areas where the copy does not reflect sufficient light. The flash extends the tonal range and also flattens the negative slightly because the flash increases the size of the dots in the shadow areas.

If you have a flat, grayish print, you may be able to reproduce the shadow end of the scale with a *shorter* detail exposure and then provide additional highlight separation with a bump exposure.

When a camera operator is shooting a halftone, the operator often places a gray scale on the copyboard next to the copy so that it will also reproduce on the negative. The camera operator then examines the copy before exposure. If the brightest highlight of the copy matches step one on the gray scale and the darkest shadow matches, say, step 10, the operator simply checks for a 90 percent dot and a 10 percent dot in these steps of the gray scale as the film is being developed. This procedure eliminates searching for the selected highlight and shadow areas on the negative. If the dot formation is correct in these steps, the middletone dots will probably be correct also. Since this is not *always* true, camera operators should also check for the location of the gray scale step that has a 50 percent dot. (See fig. 8-17.) If you are using a square dot halftone screen, the 50 percent dots (middletone dots) will form a checkerboard pattern.

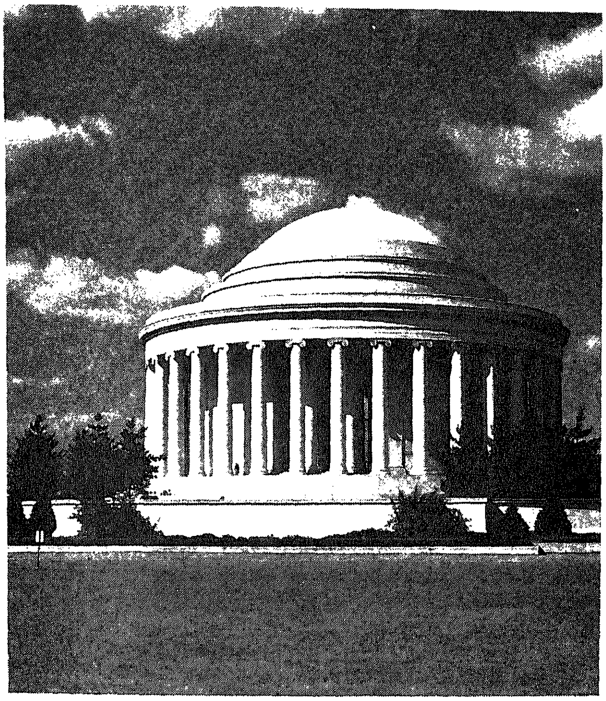
The position of the middletone or 50 percent dot on the gray scale determines how the middletones will look in the final printing. When you are using a gray scale, the middletone dot will usually fall on a step that has a density reading of 0.60 to 0.65 when the 90 percent dot falls on step one, which has a 0.00 reading. This is true when you are trying to duplicate the middletones as they appear on the original copy. However, if the middletones are too dark or too light on your copy and you want to change them on the negative, then vary your exposure and development procedures. This variance will move the 50 percent dot to a higher or lower step on the gray scale. (See fig. 8-18.)

If you double or half the exposure time, the dots will move 30 density units up or down the gray scale. For example, if you double the exposure, the 50 percent dot will move from the step

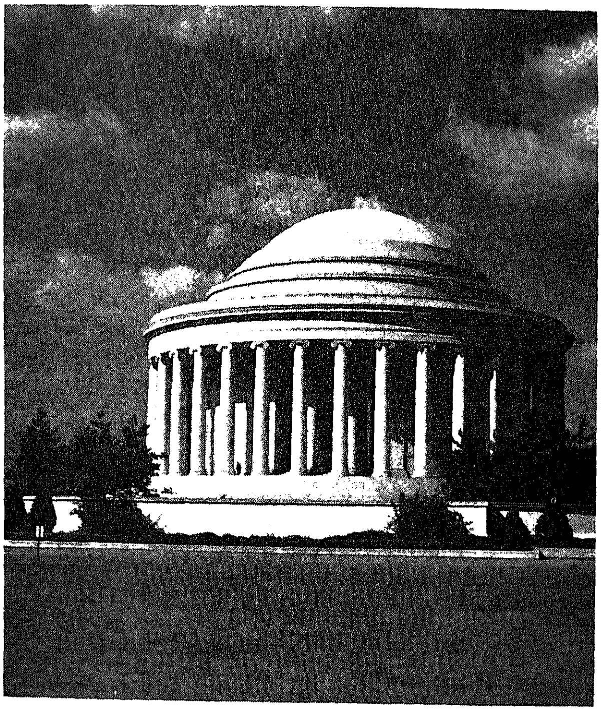


57.120

Figure 8-17.—The 50 percent dots of a square dot halftone screen.



MOVING THE 50 PERCENT DOT TOWARD THE HIGHLIGHT END OF THE SCALE DARKENS THE MIDDLETONES.



57.723X/57.724X

Figure 8-18.—Movement of 50 percent dot affects the middletones.

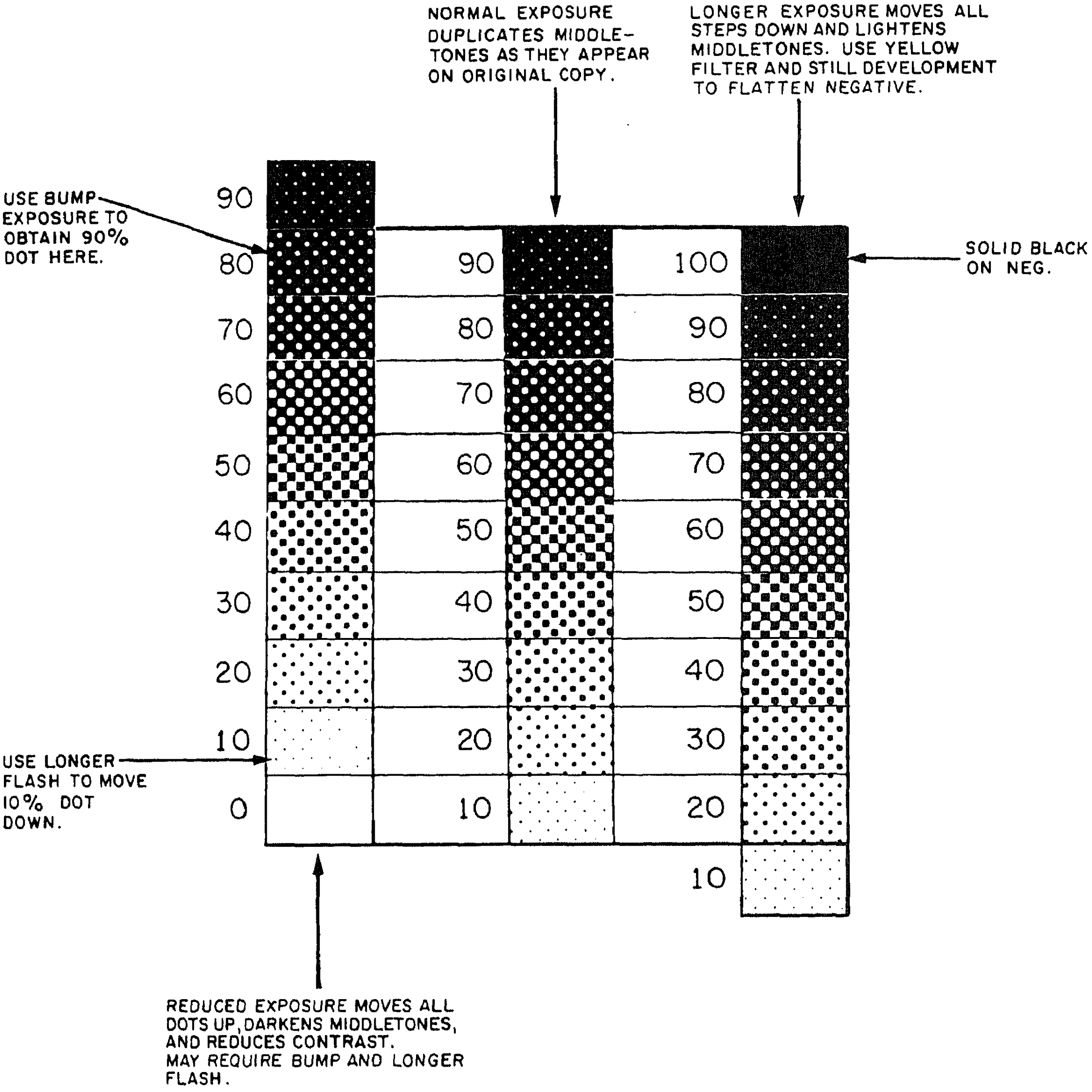
marked 0.65 to the step marked 0.95 on the gray scale. If you increase the exposure four times, the dot will shift 60 units (to the step marked 1.25), and so on.

The placement of the 50 percent dot depends on the copy, paper stock, and whether you want to emphasize the highlight or the shadow areas. If the copy is dark and you want the middletones to print lighter in the finished product, you should lengthen the main exposure, use a yellow filter, and/or use no agitation during part of the development time. Now the 50 percent dot moves from a lower to a higher density step (farther away from step one on the gray scale). If the copy is too light and you want the middletones to print darker, decrease the main exposure or use a magenta filter or a bump exposure. This moves the 50 percent dot from a higher to a lower density step (closer to step one on the gray scale).

Of course, when you move the 50 percent dot, you also shift the position of the dots in the other steps of the gray scale, and this affects the contrast of the negative. (See fig. 8-19.) As the 50 percent dot is moved toward step one, for example, the negative tends to lose contrast. You can restore the proper overall contrast when the main exposure is shortened by adding a bump exposure or by varying your flash exposure. You should increase the flash exposure time when you reduce the main exposure, because this increases the highlight detail and leaves less detail (more excess density) in the shadow areas.

If your main exposure is too short, the highlight dot shifts so that there is an 80 percent dot in step one instead of the desired 90 percent. Now it is necessary to use a bump exposure to enlarge the highlight dots and put a 90 percent dot back into step one. (The bump exposure tightens the highlights and shortens the distance between the gray scale steps containing the 90 percent dot and the 50 percent dot.)

At times, camera operators will need to move the middletone dot to the next higher density step on the gray scale to get better shadow detail. This increased shadow detail will produce a higher quality product when the image is to be printed on soft, absorbent paper stock. However, if the image is to be printed on smooth, coated paper stock, the camera operator might need to move the middletone dot towards the 0.50 density


NORMAL EXPOSURE DUPLICATES MIDDLE-TONES AS THEY APPEAR ON ORIGINAL COPY.
LONGER EXPOSURE MOVES ALL STEPS DOWN AND LIGHTENS MIDDLETONES. USE YELLOW FILTER AND STILL DEVELOPMENT TO FLATTEN NEGATIVE.
USE BUMP EXPOSURE TO OBTAIN 90% DOT HERE.
SOLID BLACK ON NEG.
90
80
70
60
50
40
30
20
10
0
90
80
70
60
50
40
30
20
10
100
90
80
70
60
50
40
30
20
10
USE LONGER FLASH TO MOVE 10% DOT DOWN.
REDUCED EXPOSURE MOVES ALL DOTS UP, DARKENS MIDDLETONES, AND REDUCES CONTRAST. MAY REQUIRE BUMP AND LONGER FLASH.

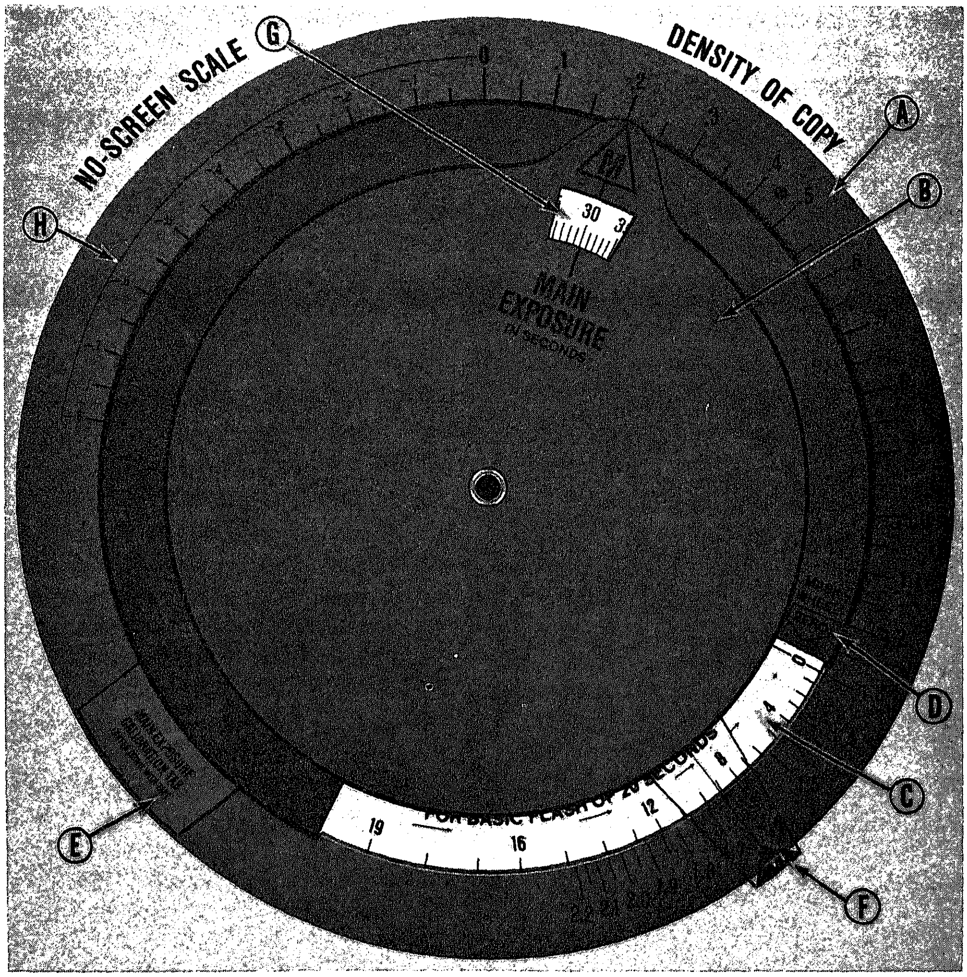
57.725X

Figure 8-19.—Effects of reducing or lengthening the main exposure.

KODAK HALFTONE NEGATIVE COMPUTER

The Eastman Kodak Company produces a device named the Kodak Halftone Negative Computer. (See fig. 8-20.) It is used to accurately determine halftone negative exposures. This computer comes with instructions for its use. The halftone negative computer consists of a series of disks attached to a card so the disks can rotate. Printed on the card is a scale (A) representing the densities of the highlight and shadow areas of the copy. You can rotate the main exposure dial (B) to move the arrow (M) along this scale when calibrating the computer or when determining your exposures. The basic flash dial (C) is divided into four sections. Each section represents one of the four basic flash times. When you are calibrating the computer, rotate this dial until the section corresponding to your basic flash appears in the cutaway area of the mask wheel (D). The tab (E) is used to move the basic main exposure time into the window (G).

To calibrate the computer for your particular camera setup, you must make a test negative of



A. Copy density guide. The upper right portion of the scale represents the highlight density reading for the copy and the lower right portion represents the density reading for the shadow areas of the copy.
B. Main exposure dial. Turn to move arrow (M) along scale (A) when calibrating the camera or determining exposure time.
C. Basic flash dial. This dial is divided into four sections or scales—one for a basic exposure of 10 seconds; one for 15 seconds; one for 20 seconds; and one for 25 seconds. If the trial negative shows that your basic exposure time is 20 seconds, turn the dial until the 20 second segment of the scale is showing in the cutaway section of the mask wheel (D).
D. Mask wheel. Turn until the right edge alines with the zero on the proper segment of dial (C).
E. Main exposure calibration tab. Rotate until the number corresponding to your basic main exposure appears in window (G) when calibrating the computer.
F. Flash pointer. Move to the number on scale (A) that represents the shadow density of your original when computing the flash.
G. Window
H. Scale used in determining bump exposure.
M. Arrow

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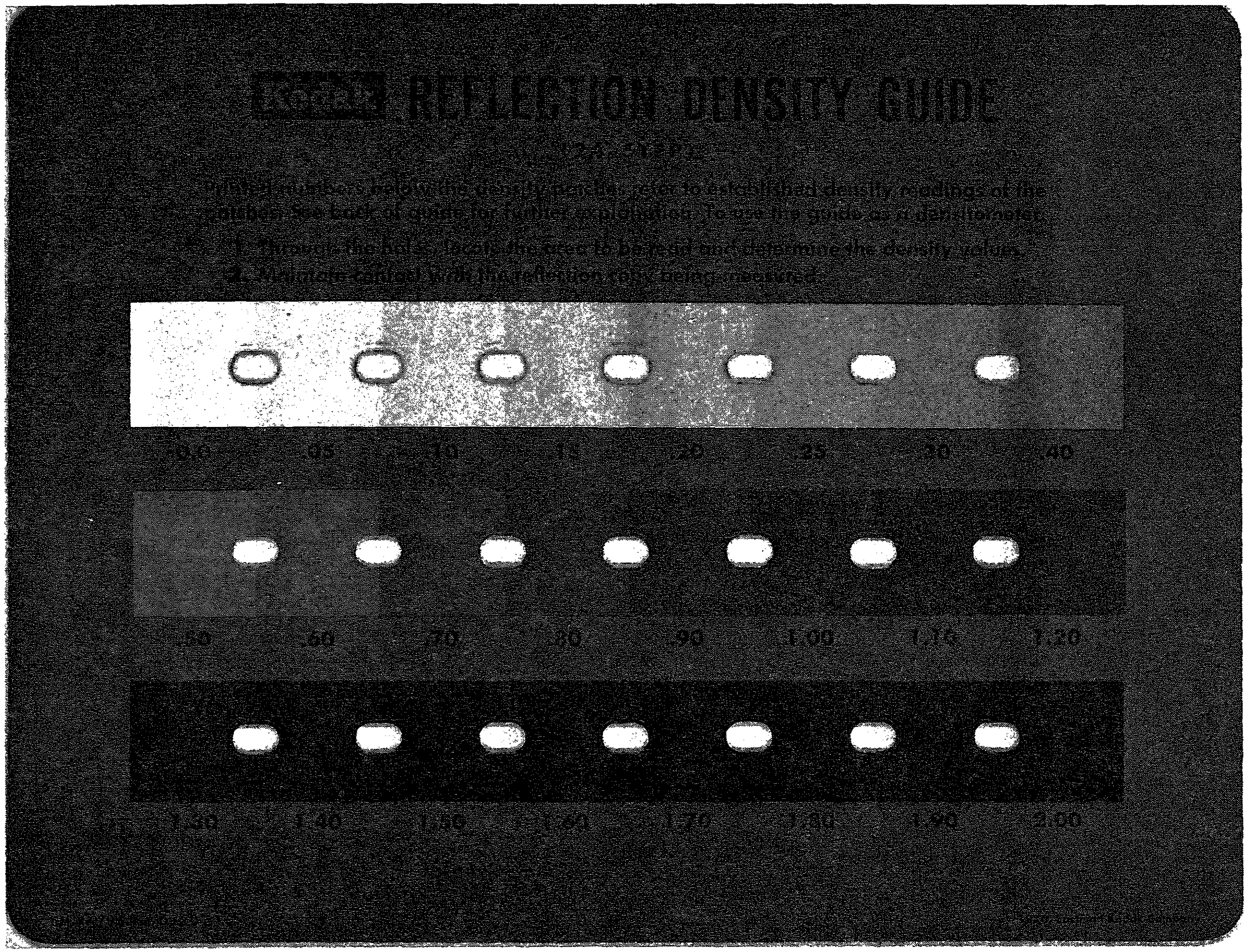
57.726X

Figure 8-20.—Kodak Halftone Negative Computer.



The numbers below the density patches refer to established density readings of the patches. See back of guide for further explanation. To use the guide as a densitometer:

1. Through the holes, locate the area to be read and determine the density value.
2. Maintain contact with the reflection copy being measured.

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57.727X

Figure 8-21.—Twenty-four step Kodak Reflection Density Guide.

a 24-step Kodak Reflection Density Guide (gray scale). (See fig. 8-21.)

The steps for producing the test negative are as follows:

1. Set the camera for a same-size (one-to-one) shot and use a lens opening that is two stops down from your camera's largest lens opening.
2. Use a strip of the black paper that separates the film in its box to mask off a 1-inch strip along the edge of the film so it will not be exposed when you make your first exposure.
3. Expose the negative for approximately 30 seconds.
4. After making this exposure, uncover the unexposed strip of film and cover the exposed area.
5. Using the camera-back flash technique, make four step flash exposures at 10, 15, 20, and 25 seconds along the unexposed strip, repeating step 4 after each exposure.
6. Develop the film for the recommended time.
7. Examine the negative to determine which steps of the gray scale have the correct dot formation. Refer to the instructions supplied with the computer to help you interpret the results of your test negative. You can then use this information in calibrating your computer, following the instructions that come with the computer package.
8. Once the computer is calibrated, tape the main exposure calibration tab (E) in place, and fasten the basic flash dial (C), the mask wheel (D), and the main exposure dial (B) together. The computer is then ready for use, and you will have a reliable tool to aid you in producing halftone negatives.

To use the halftone computer, you should measure the highlight and shadow densities of each new piece of copy with a densitometer or a Kodak Reflection Density Guide. Rotate the main exposure dial (B) until the arrow (M) is pointing to the reading on the copy density scale (A) that corresponds to the highlight density of the copy; then look at the window (G). The number in this window represents your main exposure time.

Next move the flash pointer (F) to the number on the copy density scale (A) that represents the shadow density of your original. The line on the pointer will intersect the number on the flash scale (C) that represents your flash exposure time.

This exposure computer can also be used for determining bump exposures, for making corrections for low-density copy, for moving the middletone (50 percent) dots higher on the scale, and so on. The other scale (H) is used for determining bump exposures.

The computer can be used with both magenta and gray contact screens and for making halftones with Autoscreen film. Autoscreen film will be discussed later in this chapter.

AUTOMATIC EXPOSURE COMPUTERS

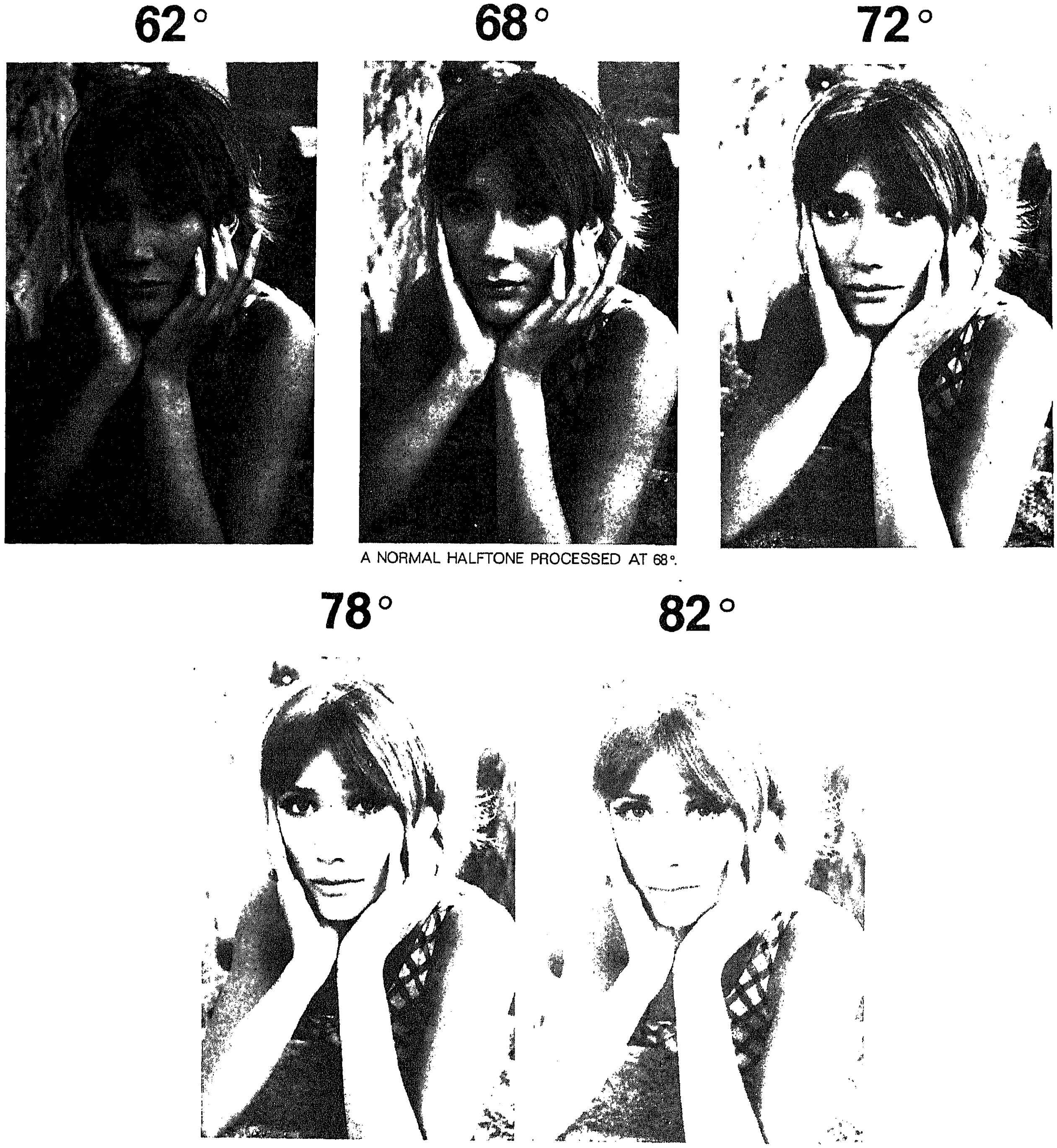
In large shops where a great deal of halftone work is done, camera operators use a densitometer to determine the range of tones in the copy and in the negative. They also use an automatic exposure computer for determining their highlight and flash exposures. The densitometer and exposure computer speed up production tremendously and are very useful in shops where the film is developed by an automatic film processor, because the processor develops all film uniformly. When these film processors are used, you cannot manipulate development to make allowance for variations in copy and exposure.

Exposure computers provide more accurate timing for short exposures than can be accomplished with a regular timer. These exposure computers also serve as light integrators. That is, they will compensate for such things as faltering lamps, lights darkening with age, fluctuations in line voltage, and changes in the position of the lamps by reducing or extending the exposure time to allow for such light variations.

In addition, exposure computers automatically compute the main and flash exposures for each piece of copy. They are preset for the density range of the screen and the basic flash exposure. For each piece of copy thereafter, the camera operator turns a dial on a control panel to feed the highlight and shadow density information into the computer. Then the computer automatically calculates the main and flash exposures. It also adjusts the flash exposure to compensate for camera bellows extension and the amount of flare caused by the main exposure. Some computers automatically calculate the highlight (bump) exposure for short-range copy, when it is required, and reduce the main exposure accordingly. To make the exposures automatically, the camera operator simply pushes the main-, flash-, or bump-exposure button.

DEVELOPMENT OF HALFTONE NEGATIVES

The temperature of the developing solution is particularly important in the processing of halftone negatives. (See fig. 8-22.) Since most film manufacturers recommend that processing solutions be kept at a temperature of 68 °F, you should keep your processing solutions as near as possible to their recommended temperature. This is important because a variation of 2 degrees in the developer equals a change of 15 seconds in development time. You should check the temperature of your solutions with a thermometer at regular intervals even when you are using a


62°
68°
72°
A NORMAL HALFTONE PROCESSED AT 68°.
78°
82°

57.728X

Figure 8-22.—How the temperature of the developer affects the contrast of the halftone. The same exposure and development times were used in each instance, but the temperature of the developer was varied.

temperature-controlled sink. You will have problems if you try to develop your halftone film when the developer is below 68 °F because the developer will not function properly at lower temperatures.

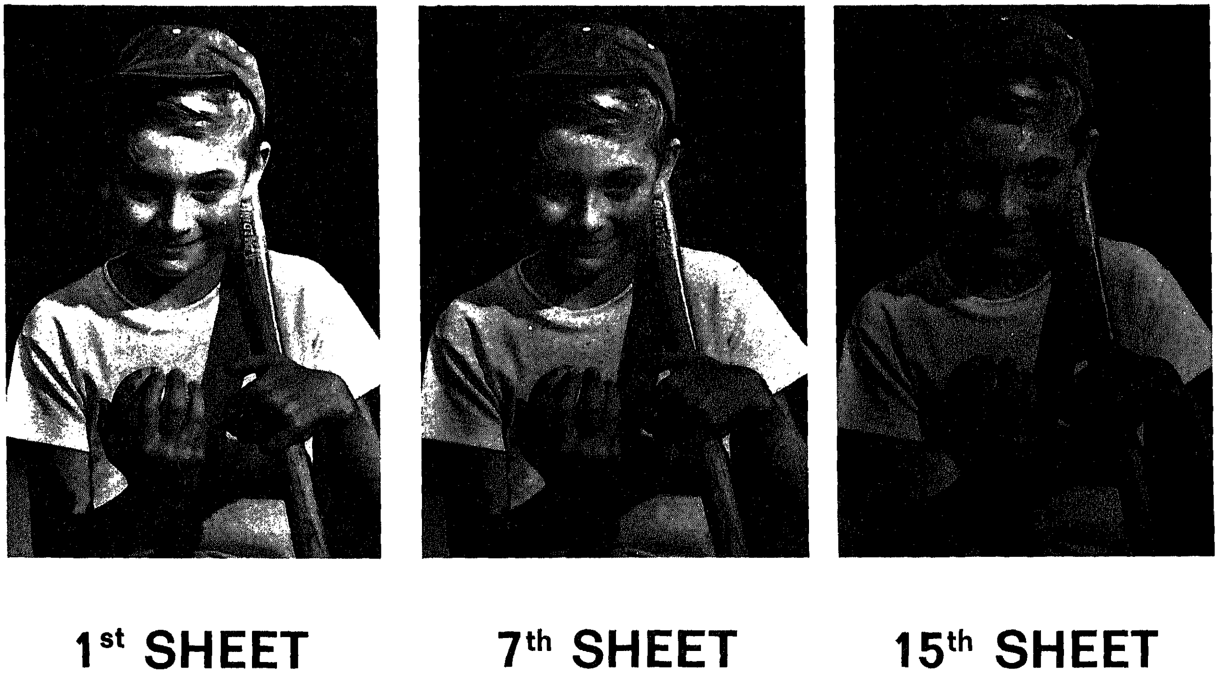
However, some films made for use with automatic film processors can be developed in solutions with temperatures up to 90 °F. If you are using this type of film, maintain your solution at the manufacturer's higher recommended temperature. The important thing to remember is that once you have decided on a workable temperature, you should maintain it consistently for all your work.

STRENGTH OF DEVELOPER

The strength of the developing solution is also important when you are processing halftone film negatives. Developers lose strength with use, age, oxidation, and contamination. When you are mixing processing chemical solutions, be sure to follow the directions on the container of developer concentrate carefully. Since developers lose strength rapidly with use, camera operators change their developer after processing every 5 to 15 negatives. How often you change your developer depends on the size of the sheets of film, the exposed area on the film, and the amount of processing solution held in the developing tray. You might need to extend the development time slightly as the solution starts to lose its strength. You should also allow for this time extension if you are developing by the time-temperature method. As the developer loses its strength, it will be increasingly difficult to bring up the proper shadow dots, even though the highlights may still look alright. You may also wish to vary your exposure or extend development in order to keep from placing fresh developer in the tray near the end of the day.

DEVELOPING TIME

Developing time affects the quality of the dots and the range of tones in your halftone negative. An average developing time is about 2 1/2 to 2 3/4 minutes; however, it may vary according to the type of film you are using, so you should use the time recommended by the manufacturer for your particular film and developer. Of course, when you are developing by the time method, you can vary the development time if necessary to compensate for variations in exposure and exhausted developer. (See fig. 8-23.)



57.729X

Figure 8-23.—Illustration showing the effect of exhausted developer on negative quality.

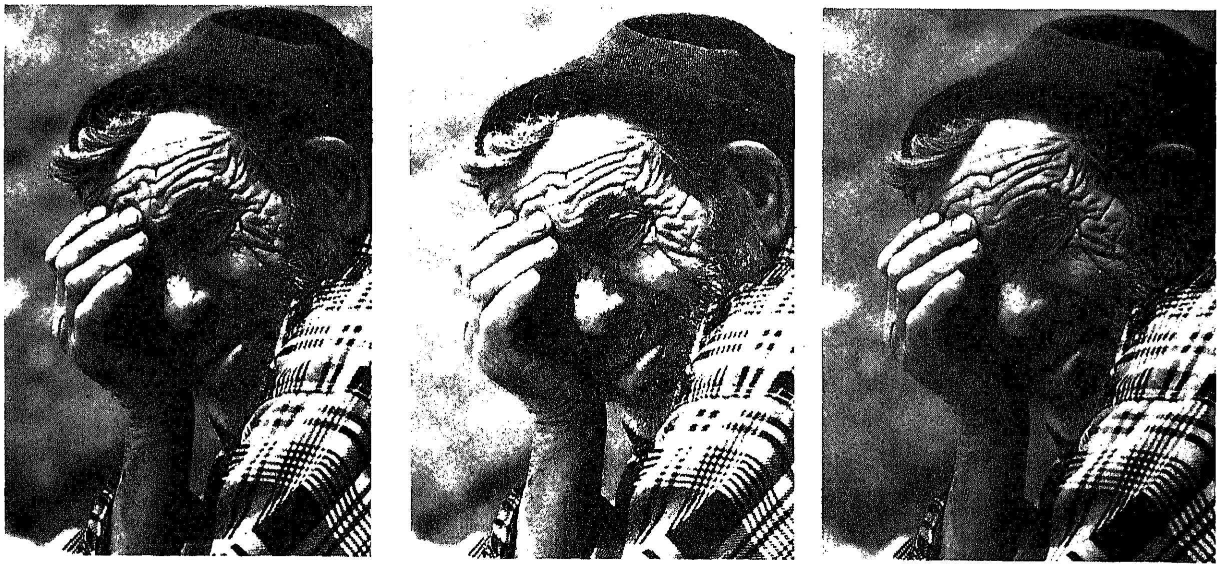
When automatic film processors are used, contrast is controlled largely through using the required exposure, because development of the negative is mechanical. Many operators follow this control technique for all work, even if their shop is not equipped with an automatic film processor. If contrast is controlled through using the required exposure, it is possible for the camera operator to develop a machine-like technique that will provide consistent results for all negatives.

AGITATION

Agitation affects the contrast of the halftone negative. Rapid agitation of the film in the developer increases the size of the highlight dots and provides greater contrast. On the other hand, no agitation (still development) increases the size of the shadow dots and reduces the contrast. (See fig. 8-24.) You should develop the film with limited agitation in most instances, but sometimes (as when a bump exposure is used) still development will be required to keep the highlight areas from plugging up. In these cases, you should agitate the developer for the first few seconds and then stop all agitation during the last minute of development. This method of still development produces open highlights and larger shadow dots, reducing the overall negative contrast. It also brings out extremely fine detail in the negative.

DEVELOPING BY INSPECTION

It may be desirable to develop the film by inspection because of variable factors such as the diminishing strength of the developer and small light variations during exposure. Halftones are more critical than line negatives. If a detailed examination of a halftone is necessary during development, you should stop the action of the developer while you make the inspection. You can stop the action by rinsing the film in freshwater or a mild stop bath (acetic acid solution). The acid rinse will stop the developing action more abruptly than freshwater, but if you use a stop bath, the film must be rinsed in freshwater before it is returned to the developer. If the acetic acid is not removed, it will weaken the developer and can cause underdevelopment in certain areas of the film.



NORMAL AGITATION

BRISK AGITATION

STILL DEVELOPMENT

57.703X

Figure 8-24.—How agitation affects contrast. The same exposure and development times were used in each instance, but the amount of agitation during the development period was varied.

You won't have to rinse the film in either water or a stop bath if you make a *brief* examination of the negative. However, you should know where the highlight and shadow areas are located on the film so you will not lose time looking for them. It is a good idea to make a mental note of the location of these areas on the copy before you make your exposure and then associate the areas with corresponding areas on the negative. This procedure is difficult if you make several exposures of different pieces of copy and then process these negatives as a group.

It takes experience to be able to develop a halftone negative by examination properly. In general you should watch the overall contrast between the brightest highlights and the shadow areas, looking for detail in clothing and highlights in the hair or in other suitable areas of the negative. You should also check to see that the highlight dots are joined together with a small, round opening in the center, that there is a square middletone dot, and that there is a 10 percent pinpoint dot in the shadow areas. Shooting a gray scale along with your copy will simplify this procedure because you can then simply check for the correct halftone dots in selected steps of the gray scale.

Beware of false highlights! During development it may look as if you have a 90 percent dot in the highlights, but you may find when the negative comes out of the hypo that you have only an 80 percent dot. This will print a 20 percent dot in the highlights when the job is run on the press, and you will have produced a flat print.

You can make your inspection by looking at the negative with a 10-power magnifying glass (linen tester) while you hold the negative up in front of the safelight. If the magnifier is held too close to the film emulsion, however, heat from your hand may warm the developer and cause overdevelopment in areas of the film. Most darkroom sinks have a small built-in waterproof light table for examining negatives during development. If your shop is equipped with this viewing device, you can lay the negative on the glass top when you make your inspection.

If your inspection of the negative indicates that the shadow areas have no opaque dots and that there are no transparent dots in the highlights, the negative is too contrasty. This means that you should adjust your flash to increase the size of your shadow dots and reduce your main exposure to regulate the size of your highlight dots. You can regulate the size of the dots to some extent during development; of course, this is not possible if your inspection shows that the dots are not coming up (developing) properly or that they are coming up too fast.

Vigorous agitation during the latter part of the development period shortens the tone scale and increases contrast, whereas still development extends the scale and decreases contrast. Once the film has developed to the point where the image becomes visible, vigorous agitation will cause the highlight dots to grow more rapidly than the shadow dots, and still development will bring up the shadow dots more quickly. Therefore, if you find the shadow dots are coming up faster than the highlights, use rapid agitation for the remainder of the development period. When the shadow dots are small while the highlights appear to be correct, use still development for the remainder of the period. (Although still development brings up larger shadow dots, they are sometimes weak and may burn out [not stop light] when the plate is exposed.)

Halftone negatives are fixed, washed, and dried in the same manner as line negatives. You have already seen how processing and drying of negatives are done.

SCREEN SELECTION

Because the contact halftone screen is used in direct contact with the film emulsion, it does not use a sharp crossline pattern to form the halftone dot. The screen has a diffused pattern that is often described as *vignetted* because there is a gradual decrease in density from the center to the outside of the dark area of the screen's pattern. Dot formation is controlled by the lens opening of your camera.

Even though halftone contact screens have similar characteristics, they do differ because of the manufacturing process used. Lithographic camera operators should select screens based on the particular job they are to perform, the equipment available in their shops, or their familiarity with a specific type of screen. Now let's examine other types of contact screens.

GRAY CONTACT SCREENS

Although the negative magenta screen is the most commonly used contact screen, some camera operators prefer gray screens because they require less exposure time. Gray screens also have a built-in bump exposure. They have an average density range of 1.05 as compared to the density range of 1.15 to 1.20 of magenta screens. Since the gray screens are more contrasty and have a shorter tonal range than magenta screens, they are slightly more difficult to use.

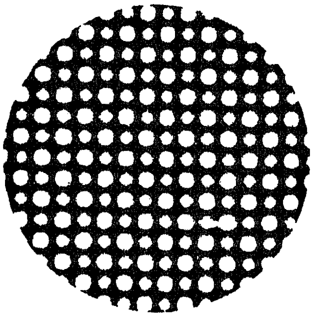
The gray screen is used for black-and-white halftone negatives. It is used much the same as the magenta screen except that the gray screen depends on factors other than the use of colored filters for contrast control. As you have just seen, the gray screen's built-in bump exposure increases the contrast of the negative when they are arranged in the normal manner (emulsion to emulsion). You can also increase the contrast in the negative by placing the screen over the film on the vacuum back so that the emulsion side is away from, rather than against, the film emulsion. A very slight separation between the screen pattern and film emulsion shortens the screen range and heightens the contrast of the negative. You can also control contrast by manipulating the flash exposure to produce the desired dot sizes in the shadow areas. Also, by manipulating the period of agitation during development, you can control the contrast in the highlight areas; or by making a bump exposure, you can increase the highlight separation.

ROUND DOT SCREENS

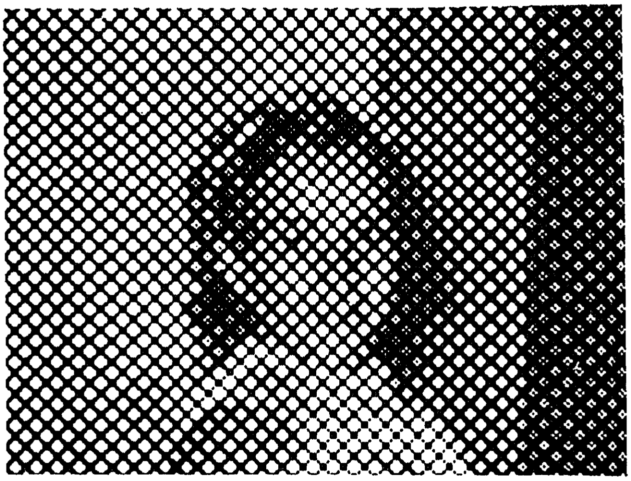
Round dot screens produce round rather square dot screens, giving greater contrast control. They also produce shadow detail better than square dot screens. They are available in magenta or gray in a variety of sizes and rulings.

RESPI CONTACT SCREENS

The Respi screen shown at the top of figure 8-25 produces a double dot pattern, like that shown at the bottom of figure 8-25. This pattern gives better retention of detail and is ideal for halftones that are to be printed on rough or poor quality paper. Because of this special dot pattern, a 100-line (screen)



DOT PATTERN OF A RESPI CONTACT SCREEN.



MAGNIFIED SECTION OF HALFTONE PRINT SHOWING THE DOUBLE DOT PATTERN PRODUCED WITH A RESPI SCREEN.

ruling is roughly equal to a normal 133-line screen with regard to the retention of detail. Negative and positive Respi contact screens are available in both gray and magenta and have either square or elliptical dot patterns. The negative screens have a built-in bump exposure to provide the required contrast.

SPECIAL-EFFECT SCREENS

The illustrations shown in figure 8-26 were produced by shooting continuous-tone copy through special-effect contact screens. Special-effect screens are available in rulings of 50 lines and up. They are similar to regular gray contact screens but are lighter in contrast (are more transparent) to allow for faster exposure and provide more control in converting continuous-tone originals into line work. Special-effect screens are often used for advertising copy and for other types of work where it is desirable to simulate line drawings, engravings, and so on. These screens are available in a number of different patterns, including wavy line, crossline, steel engraving, etching, contour, circle (which produces an image consisting of concentric circles), and mezzotint (which produces a stippled image).

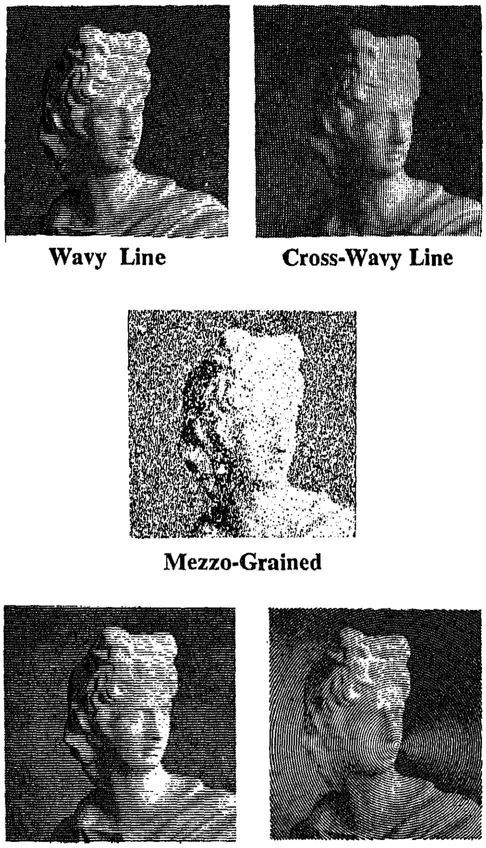
Figure 8-27 shows how these special-effect screens and other techniques may be used to produce striking and unusual results. The illustration in the upper left corner of figure 8-27 is from a halftone negative produced from the original copy of normal contrast. The illustration in the upper right corner is the result of a line shot made from the original. (The original was retouched slightly in this case to prevent some of the lighter shadows from dropping out.) The illustration in the lower left corner is the result of photographing the original through a single-line screen. The illustration in the lower right corner was made by first making a highlight or dropout shot through a single-line screen and then making a photographic print from the negative. After this, single-line tone pattern was applied to sections of the print and it was re-photographed as a line shot.

You can produce a similar effect by first placing a single-line screen over the film with the lines running horizontally and then exposing them for approximately 20 seconds. Then turn the screen so the lines are running vertically and make another exposure for about one-third of the time used for the original exposure. This should be followed by a 10 percent bump exposure without the screen.

Not every continuous-tone original can be used to advantage with special-effect screens. Best results are obtained from the continuous-tone original when the copy has sufficient contrast to allow the dropping of whites (elimination of dots or lines in the extreme highlight areas) during the exposure.

DROPPING OUT WHITES

Halftones with no dots in the highlight areas or the white backgrounds are called "dropouts."



Wavy Line

Cross-Wavy Line

Mezzo-Grained

Single Line

Concentric Circle

57.597X

Figure 8-26.—Results produced by copying the same photograph through various special-effect contact screens.

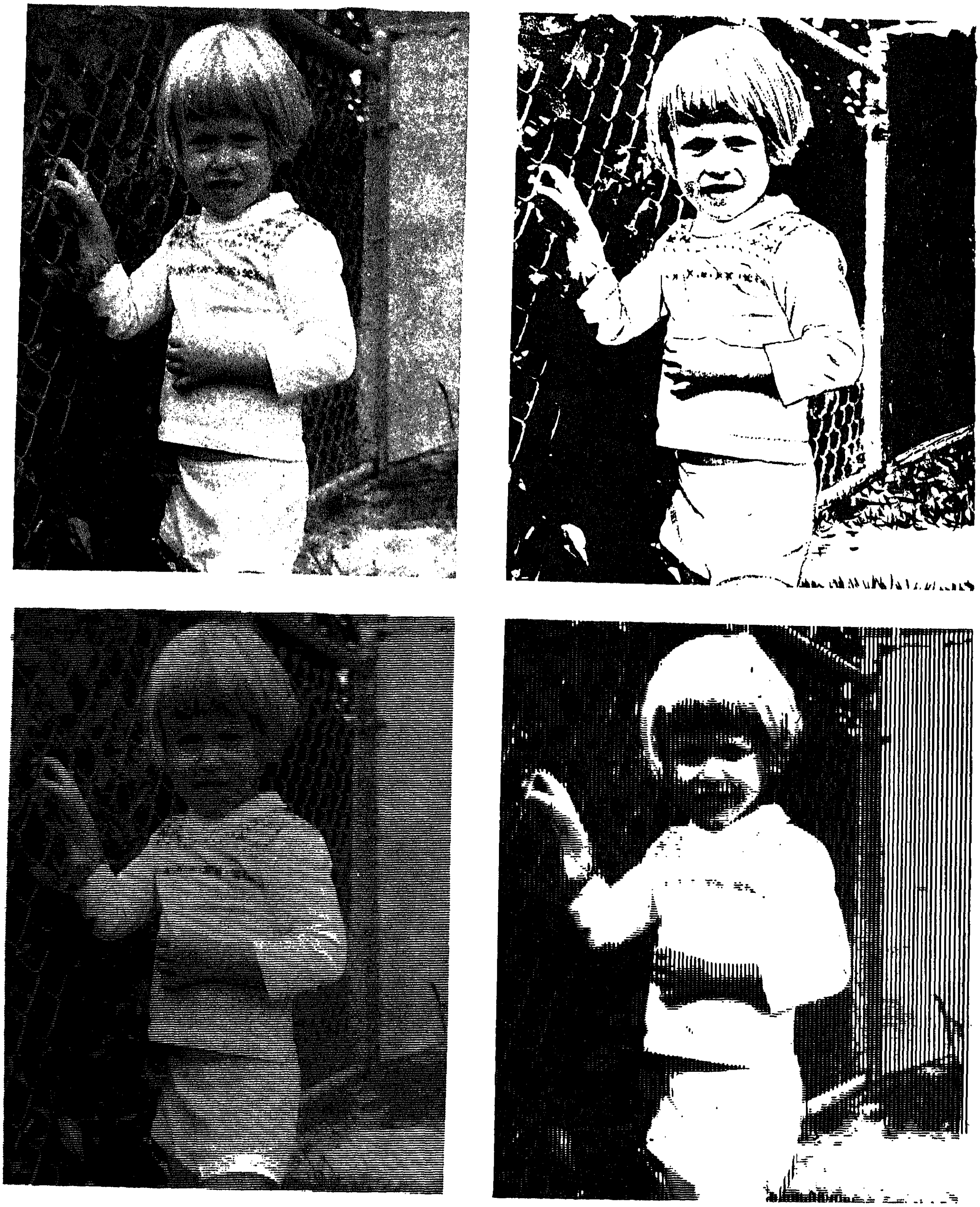
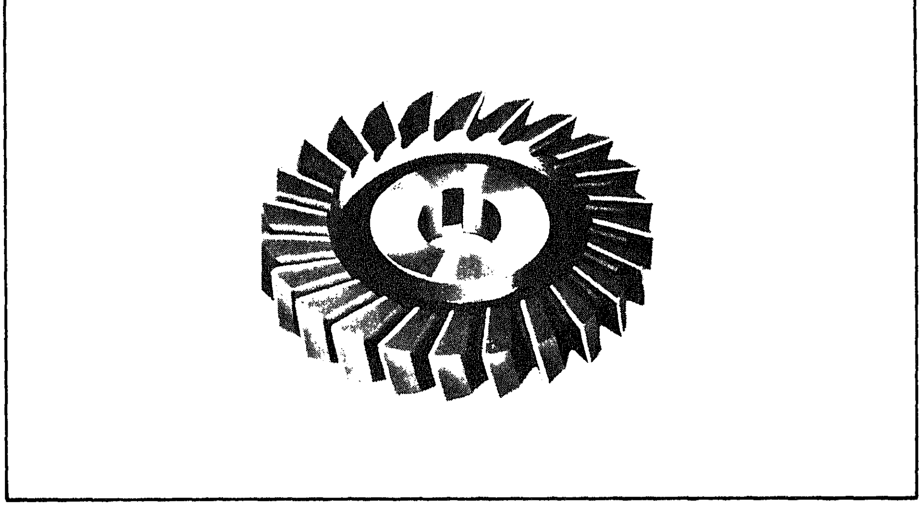


Figure 8-27.—Effects produced by various copying techniques.

57.598



28.7

Figure 8-28.—Elimination of gray dots in highlights and background "snaps up" the appearance of an illustration.

(See fig. 8-28.) These halftones produce a more striking printed product than screened illustrations. Dropout halftones are used primarily in catalogs and advertisements.

If you are working with a magenta negative screen, you may be able to obtain dropouts by photographing the copy through a magenta filter or by using an extreme bump exposure. You can also drop white by opaquing (painting out) sections of the negative or by using specially prepared masks during copying, as shown in figure 8-29.

COMBINATION WORK WITH TINTS

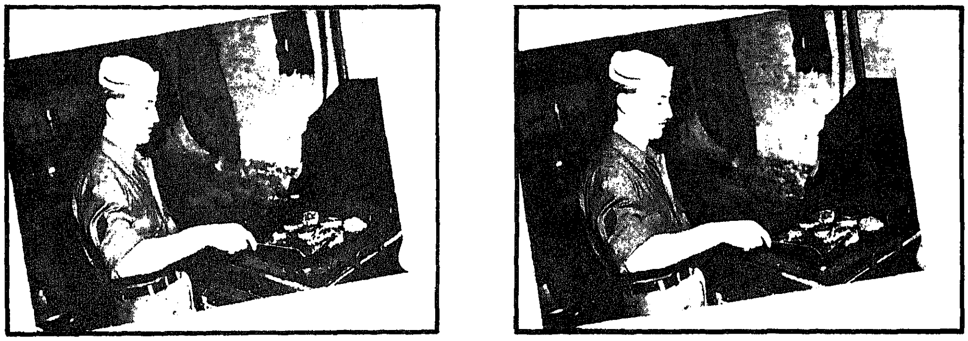
As you study figure 8-30, you can see what happens when continuous-tone copy is shot as a halftone (view A) and also what happens when the copy is photographed as a line shot (view B). Notice that the print is reproduced properly when continuous tone copy is shot as a halftone (view A) but that the print is too contrasty as a line shot (view B). As compared to view A, view B shows abrupt breaks between the shadow and highlight areas, and practically all of the middletones have been lost. An example of a screened line drawing (view C) shows lines that are soft and feathery, while another example (view D) shows the same line drawing properly reproduced as a line shot.

By comparing the results, you will see that a photograph cannot be reproduced successfully by the line shot process and that a line drawing is not at its best when shot as a halftone. In other words, each type of copy has a process suitable to produce satisfactory results, and that process should be used.

But suppose you receive a piece of copy that consists of a combination of line drawings, type, and continuous tone photographs. How would you handle that copy? If you shoot the copy as a line shot, the details of the photographs will drop out, and if you screen it, the lines and lettering will lose their sharpness. You can solve this problem in several different ways.

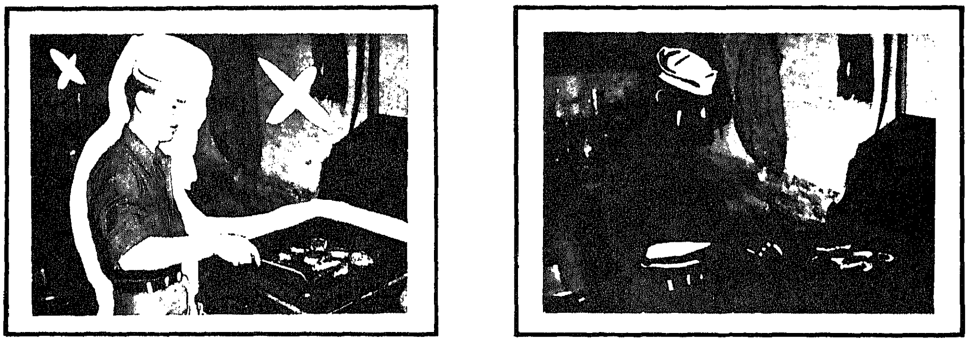
SPLICING NEGATIVES

If the line copy does not overlap the tone copy in your original, you may simply make two shots of the original—one in line and one in tone. Then you can combine the negatives by splicing them when you do the stripping operation.



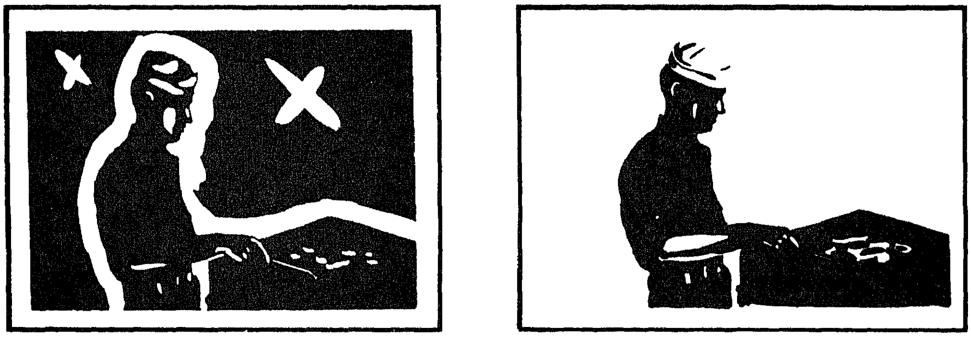
FIRST COVER THE PHOTOGRAPH OR TONE DRAWING WITH A SHEET OF CLEAR ACETATE.

FIRST COVER THE PHOTOGRAPH OR TONE DRAWING WITH A SHEET OF CLEAR ACETATE.



THEN OUTLINE THE IMAGE ON THE ACETATE AND FILL IN ALL HIGHLIGHTS TO BE DROPPED WITH CHINESE WHITE.

THEN USING BLACK INK, OUTLINE AND FILL IN ON THE ACETATE ALL PARTS OF THE ILLUSTRATION THAT ARE TO BE SHOT IN TONE.

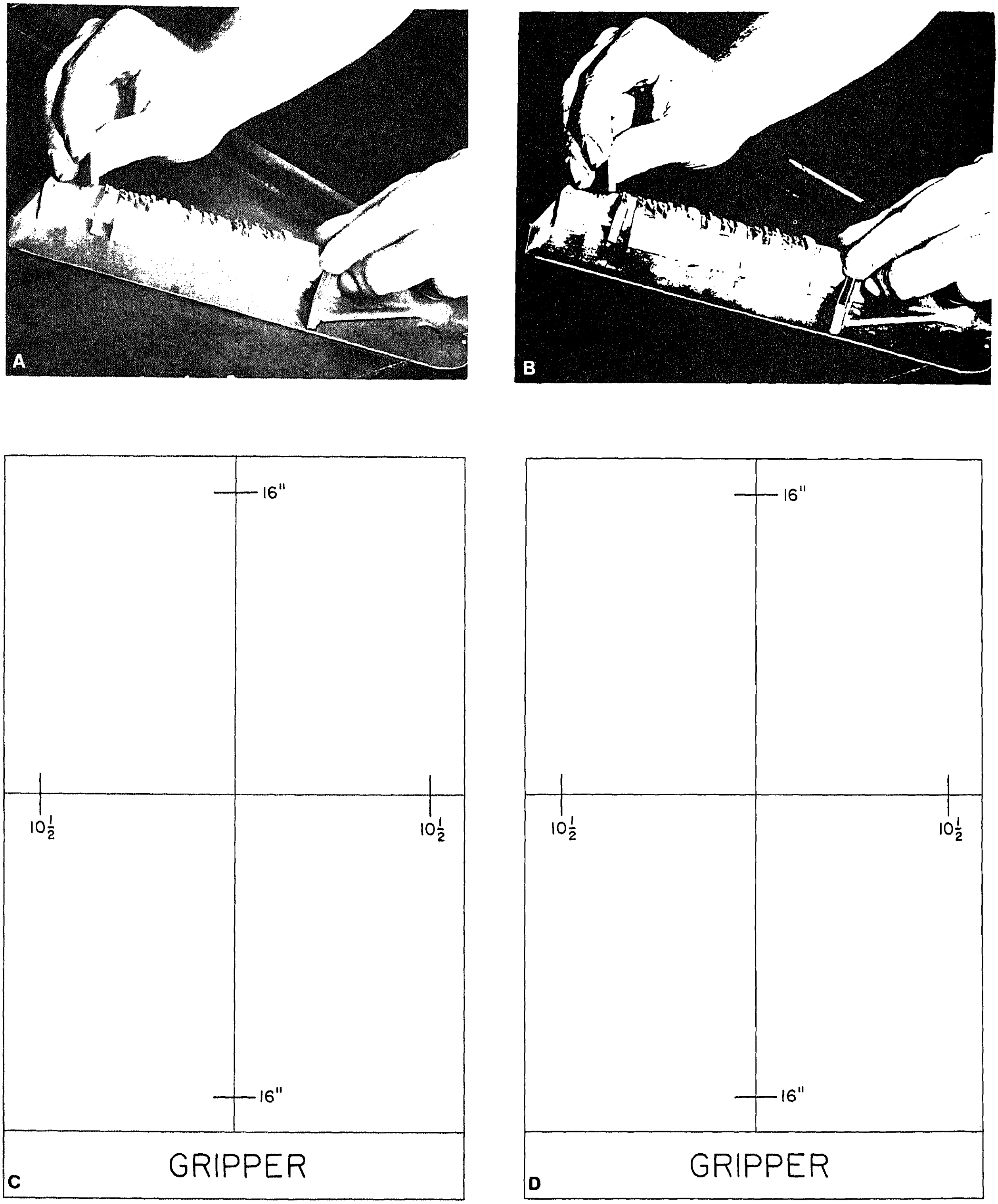


THE CAMERA OPERATOR FASTENS COPY TO COPYBOARD TO PREVENT MOVEMENT, INSERTS A SHEET OF BLACK PAPER BETWEEN THE ACETATE AND THE COPY, AND MAKES AN EXPOSURE GREAT ENOUGH TO BURN OUT ALL DOTS IN THE WHITE SECTIONS. SINCE THE AREAS COVERED BY THE BLACK PAPER REFLECT NO LIGHT, THE FILM IS NOT EXPOSED IN THESE AREAS. THE BLACK PAPER IS THEN REMOVED AND A REGULAR HALFTONE EXPOSURE IS MADE.

THE CAMERA OPERATER FASTENS COPY TO COPYBOARD TO PREVENT MOVEMENT, INSERTS A SHEET OF WHITE PAPER BETWEEN THE ACETATE AND COPY, AND MAKES AN EXPOSURE TO BURN OUT ALL WHITES AS BEFORE. HE THEN REMOVES THE WHITE PAPER, FOLDS BACK THE ACETATE MASK AND MAKES A REGULAR HALFTONE EXPOSURE.

57.133

Figure 8-29.—Two methods of dropping whites.



MASTER LAYOUTS FOR HARRIS LTE

MASTER LAYOUTS FOR HARRIS LTE

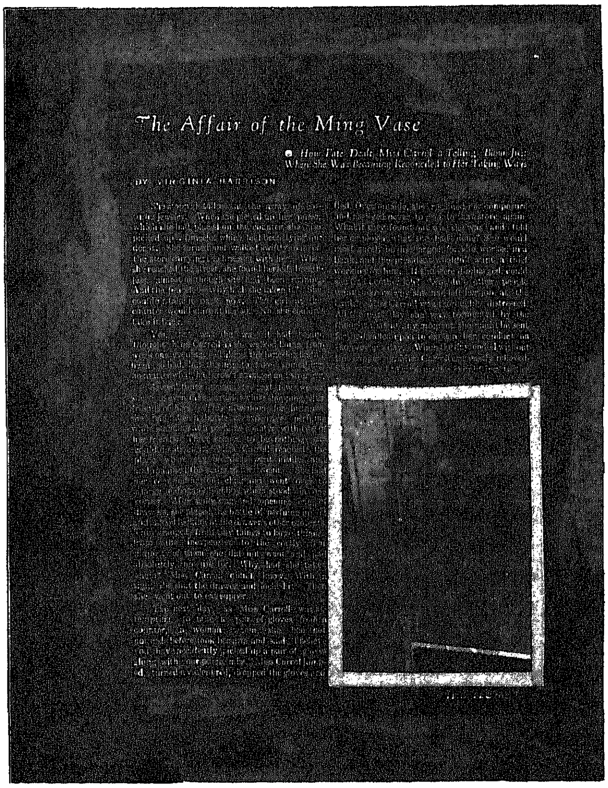
57.134

Figure 8-30.—Graphic representation of what happens when tone copy is shot as line and line copy is shot as tone.

(See fig. 8-31.) When you strip the negatives together on the flat, lay one over the other and then cut through both negatives with one cut so that perfect joints can be formed. You then remove the portions of the halftone negative from the area where the line image is to appear and remove from the line negative the area where the tone is to appear. Now splice the halftone shot of the tone copy into the cut open area of the line negative and cover the cut lines with lithographer's tape so they will not reproduce on the offset plate.

MASKING

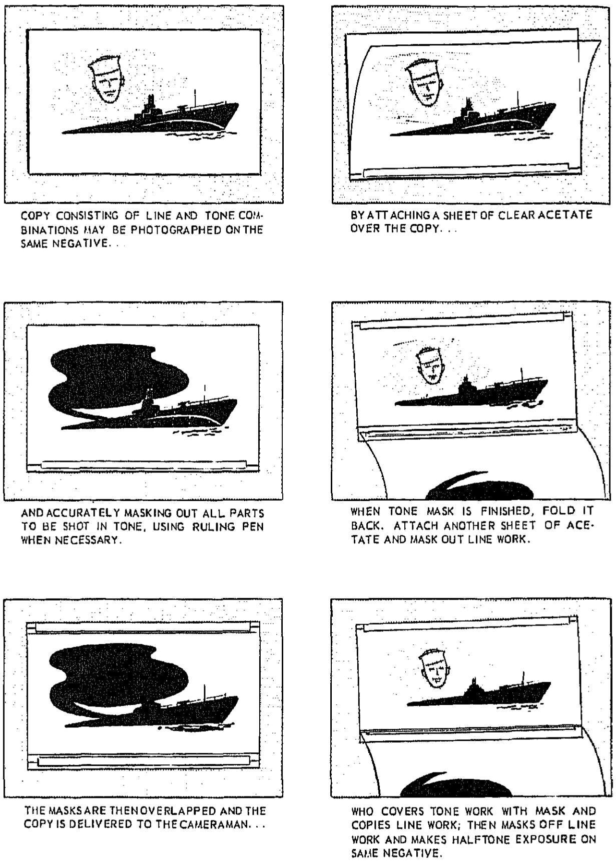
Figure 8-32 shows how masking is used in combination work. You attach an acetate overlay to the original art and ink in on the acetate all parts to be shot as *tone* copy. The drawing can be done with a ruling pen and/or brush. After you finish the mask, fold back the overlay and attach another sheet of acetate to the drawing. Next, ink in (or mask out) all *line* work on this overlay, extending the masking into the tone portions of the copy if necessary. Drawing in lines in this manner, extending them into the tone portions of the copy, is known as "holding them (the lines) solid." This last mask you just completed is your line mask (copy). Any area where the line mask overlaps the halftone mask will be reproduced as a solid color when the printing is done.



The Affair of the Ming Vase

57.135

Figure 8-31.—Line and halftone negatives spliced together for a combination job.



COPY CONSISTING OF LINE AND TONE COMBINATIONS MAY BE PHOTOGRAPHED ON THE SAME NEGATIVE. . .

BY ATTACHING A SHEET OF CLEAR ACETATE OVER THE COPY. . .

AND ACCURATELY MASKING OUT ALL PARTS TO BE SHOT IN TONE, USING RULING PEN WHEN NECESSARY.

WHEN TONE MASK IS FINISHED, FOLD IT BACK. ATTACH ANOTHER SHEET OF ACETATE AND MASK OUT LINE WORK.

THE MASKS ARE THEN OVERLAPPED AND THE COPY IS DELIVERED TO THE CAMERAMAN. . .

WHO COVERS TONE WORK WITH MASK AND COPIES LINE WORK; THEN MASKS OFF LINE WORK AND MAKES HALFTONE EXPOSURE ON SAME NEGATIVE.

57.136

Figure 8-32.—Masking for combination line and tone shots.

To make the negative, you should use the tone mask to cover the tone areas of the original art, fold back the line mask, and make the line shot. Next uncover the tone areas, cover the line areas with the line mask, and make the halftone exposure. Since both exposures are made on the same negative, you have a combination negative, and the negative-splicing operation described previously is unnecessary.

SURPRINTING

Surprinting is a procedure to follow if the line image areas overlap the tone portion of the original copy. To use this procedure, you should mount the tone copy on illustration board to make the copy easier to handle. The line copy portion of the job should be mounted or drawn on an acetate overlay sheet. To photograph the copy, you simply place a sheet of white paper under the acetate sheet and shoot the acetate line copy as a line shot. Then, change the film in the camera, fold back the acetate, and shoot the tone copy, using the halftone screen. It is up to you to combine the images of both negatives by successively stripping and exposing the image on an offset plate in register.

This surprinting procedure is effective only if the line copy is to be printed in the same color as the halftone area. This is true because both images (line and tone) will be combined on the same offset plate.

REVERSE LETTERING

Reverse lettering or any reverse line work refers to a finished product with the background printed and the line work areas left open exposing the paper stock color, if any. Refer to figure 8-30 for an example of reverse lettering. Notice that the letters *A* and *B* are left open in the top illustrations.

Also, reverse lettering or any line work over a halftone requires that a film positive be made from the line negative. The film positive must be made as large as the printing area of the halftone copy, or larger. If the positive is smaller than the halftone printing area, a line or shadow will show when the plate is made.

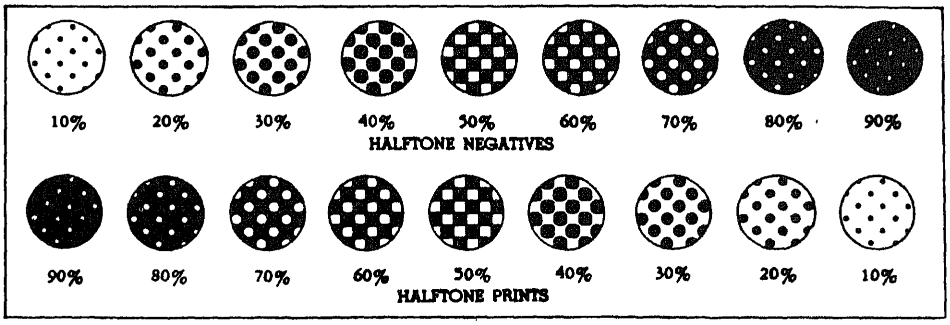
The halftone negative is stripped to the goldenrod, and then the film positive is stripped over the tone image into its proper position, producing the finished flat. The offset plate is then produced with an exposure of this flat. The line image on the film positive will block light to the plate, which will prevent an image from being produced in the area it covers. Therefore, no ink image in the line work area will be transferred to the paper stock, leaving a reverse image on the final press sheet.

Tints and tone backgrounds can also be stripped over transparent areas of line negatives to create a reverse appearance.

TINTS

You might be required to produce a tint (benday effect) in the transparent area of a line negative. You can supply the tint by covering the area with an acetate shading sheet of a suitable pattern before making your line shot. You can also make screen tints on film by photographing a piece of white paper through the halftone screen onto the film. The value (amount of color) of the tint depends on the amount of exposure and the size of the lens aperture opening used. A quarter tint means that 25 percent of the paper is covered by dots and 75 percent of the paper is left as open space. (See fig. 8-33.) A 30 to 50 percent tint is sufficiently strong for most jobs if the work is to be printed (run) in dark ink. You can also make tints by using the flashing lamp as a light source to expose your film through the halftone screen.

When you are using the shop process camera, it is difficult to produce an even tint due to difficulties in lighting, processing, and so on. Many shops buy film tints commercially and use those when a tint is required. You can also buy master tint negatives and contact print the negatives on film to produce tints as they are needed.



57.137

All film tints and tint negatives must be as large as the negative you are using, or larger. A large tint will eliminate unwanted lines or shadows in the finished product.

HALFTONE POSITIVES

A halftone positive is merely a reproduction of a halftone made in a positive medium. You can produce a halftone positive by exposure through a halftone negative in a vacuum printing frame, by re-photographing with the camera, or by projection with an enlarger. This exposure of the halftone negative can be made onto any light-sensitive surface.

In halftone positive production work, reducing or enlarging the image will affect the size of the halftone dot. Therefore, some camera operators prefer to work with the original continuous-tone positive. This positive may be retouched, enlarged, or reduced as necessary and then shot through the halftone screen to provide a new negative. This new halftone negative then produces a new halftone positive which may be retouched, enlarged, or reduced with the required dot size.

RESCREENING HALFTONES

Occasionally you will have to copy a clipping—a halftone that has been printed in a magazine or newspaper. If the screen used for the halftone in the clipping is coarse and open (less than 100 lines per inch), you may shoot the job as a line shot. If the job cannot be shot as a line shot, then the halftone must be rescreened. Rescreening is the process used to copy a halftone original through a halftone screen or onto Autoscreen film.

When you rescreen a halftone, the new dot formation often overlaps the original dot formation. This overlapping of dot formations produces a disturbing visual pattern called moire. To reduce or eliminate this moire when it forms, you should, if possible, reduce the image size, or tilt the copy to about a 30-degree angle (off vertical) on the copyboard. (See fig. 8-34.) Sometimes a screen 50 lines coarser or 50 lines finer than the screen you used for the original copy will eliminate moire.

A diffusion filter, known as a rescreener, is sometimes used over the lens in copying halftone clippings. Since the rescreener diffuses the old dot, the camera operator can use the rescreener to make continuous-tone negatives from clippings or rescreen the clippings and make halftone negatives without danger of moire.

AUTOSCREEN FILM

Autoscreen film requires no halftone screen to produce halftone negatives. During the manufacturing process of Autoscreen film, the manufacturers built into the film a halftone dot pattern. This dot pattern is produced by tiny variations in the sensitivity of the emulsion of Autoscreen (halftone) film.

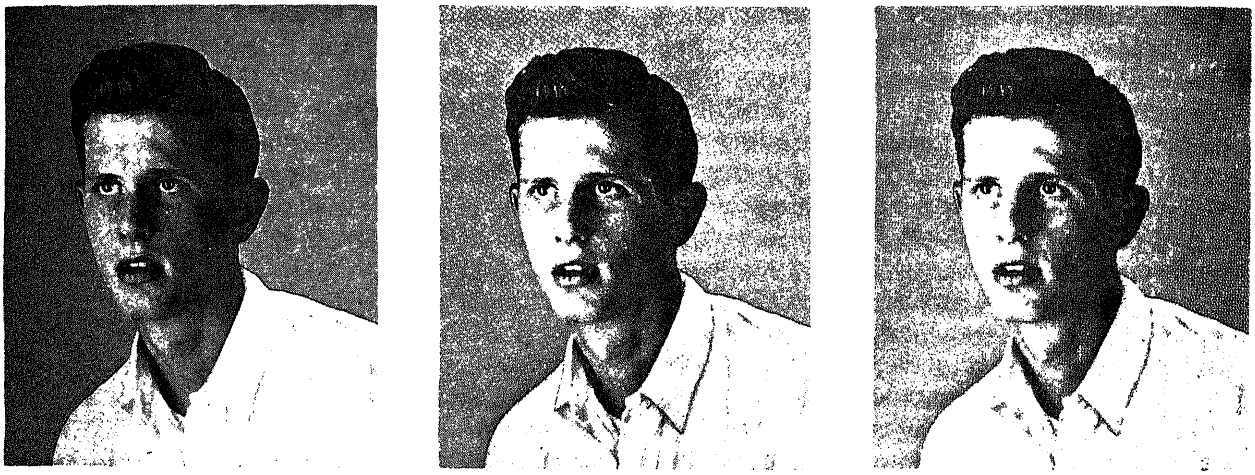
CHARACTERISTICS OF AUTOSCREEN FILM

A characteristic of all conventional film emulsions is their overall sensitivity to light. However, Autoscreen film, with its tiny variations in the sensitivity of the emulsion, is different. The emulsion of Autoscreen film is made up of thousands of tiny, light-sensitive areas. The center of each area on the film is more sensitive to light than the edge of each area. Consequently, when Autoscreen film is exposed, the light reflected from the shadow areas of the copy is so weak that it affects the center of the light-sensitive areas only and thus produces small dots. The middletones, however, reflect more light and are able to expose a larger portion of the light-sensitive areas on Autoscreen film. The reflection from the highlight areas of your copy is the brightest, so this light exposes all but small areas of the emulsion. Therefore, the halftone dot size is graduated according to the amount of light striking these areas of sensitivity on the Autoscreen film. This film can also produce sharper detail than other films requiring more complex processes.

Autoscreen film has the ability to produce the same tone scale as a 133-line gray contact halftone screen. Also, the film comes in a variety of sheet sizes.

MAKING THE EXPOSURE

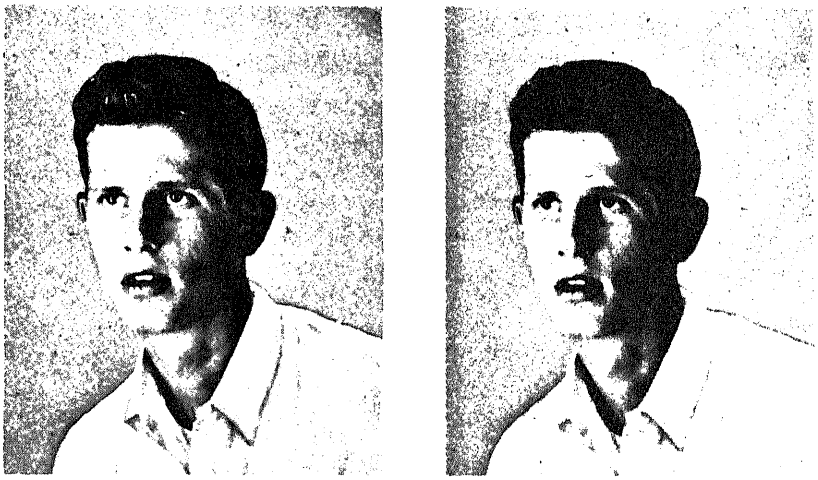
Since no halftone screen is used with Autoscreen film, less exposure is required for



SCREENED CLIPPING

HALFTONE MADE FROM CLIPPING. NOTICE MOIRE CAUSED BY RESCREENING.

HALFTONE FROM SAME CLIPPING. COPY WAS POSITIONED AT 30° ANGLE ON COPYBOARD TO ELIMINATE MOIRE.



HALFTONE FROM SAME CLIPPING. RESCREENER WAS USED IN MAKING NEW NEGATIVE.

HALFTONE FROM PRINT MADE FROM ADLUX NEGATIVE OF CLIPPING.

57.138X

Figure 8-34.—Methods of eliminating moire.

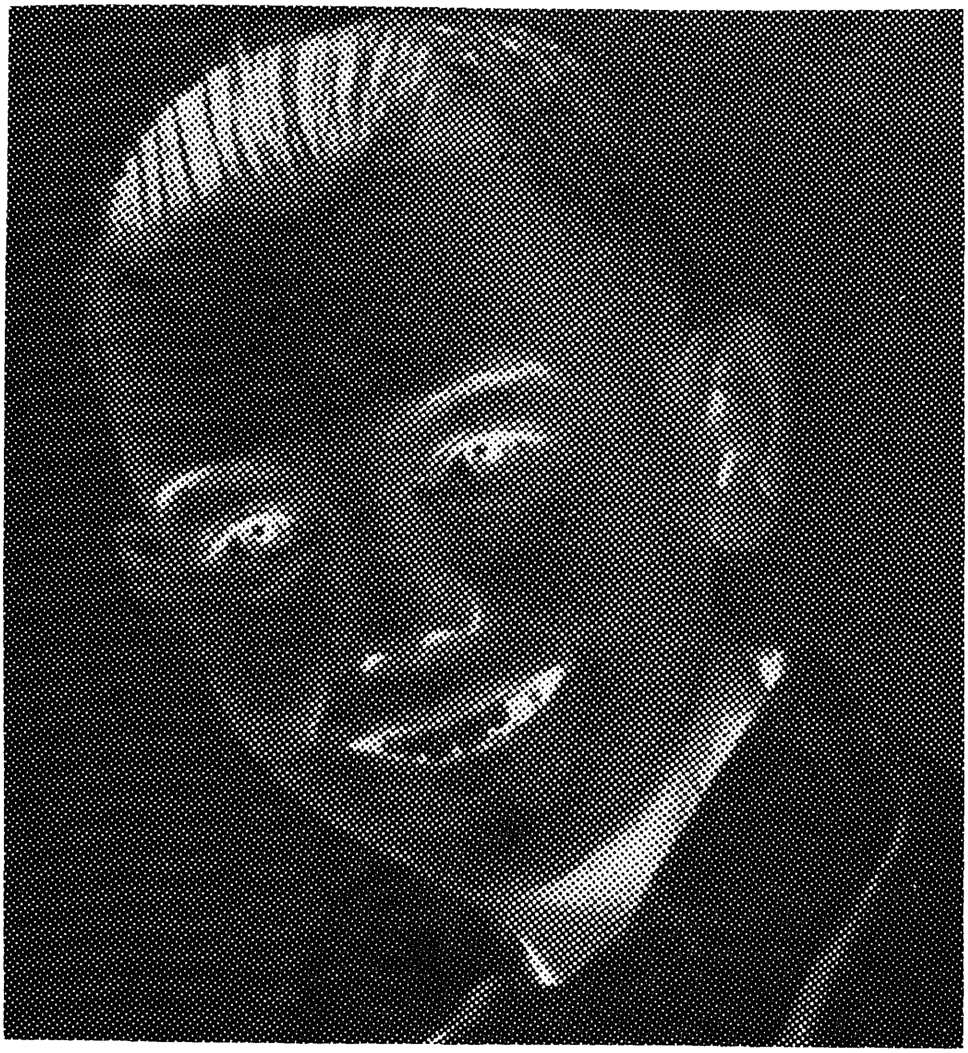
making halftone negatives. You can make a trial two-step (detail and flash) exposure by placing a gray scale and a photograph of average contrast on the copyboard and setting the camera for a same-size (one-to-one) shot at f/22. Make your detail exposures, based on the information sheet found inside the box of Autoscreen film. Then open the camera back and make a flash exposure of 30 seconds, using a flash lamp with a greenish yellow (OA) filter and following a procedure similar to that used when flashing through a contact screen. Although the procedure is similar, remember that during the flashing, no contact screen is used.

Develop the film for 2 1/2 minutes at 68 °F with continuous, slow agitation. (Several lithographic developer solutions can be used, and tray or machine processing can be employed for developing.) After the negative dries, you should examine the dot formation. You should find a 90 percent dot in the highlights and a 10 percent (or slightly larger) dot in the shadows. (See fig. 8-35.) If you do not have the required dots in your negative, you must vary your exposures until you get the required dots. Once you have obtained a satisfactory test negative, you can use its camera set up and exposure information as a basis for subsequent exposures. Of course, you might have to vary the exposure as necessary for copy of different contrast or when enlarging or reducing an original.

SUMMARY

Halftones are normally made with a contact screen. There are two main types of contact screens: the gray screen and the magenta screen. Most of your work will be done with the magenta screen.

The screen is placed on the vacuum back of the camera in contact with the film emulsion and two exposures are made. The f/16 or f/22 aperture is normally used for the main exposure. This is a white light exposure of the copy. After the main exposure is made, the camera back is opened and the film is flashed through the screen by exposure to yellow light. If the copy is very flat, it is sometimes necessary to use an exposure without



57.146X

Figure 8-35.—Illustration showing dot formation in highlight and shadow areas of Autoscreen negative (enlarged).

the screen in addition to the other two exposures. This exposure, called a bump, brings out the highlight detail.

The camera operator usually shoots for a 90 percent dot in the highlights and a 10 percent dot in the darkest shadow areas showing detail. Often they shoot a gray scale along with the original copy and watch the dot formation on the gray scale when they are developing the film.

Camera operators also check the position of the 50 percent dot on the gray scale. The 50 percent dot normally falls on the gray scale step having a density reading of 0.60 to 0.65, but they can use, with less exposure, a magenta filter, or a bump exposure to move the dot closer to step one on the gray scale and make the middletones print darker. On the other hand, the camera operators can lengthen the exposure, use a yellow filter, and/or use no agitation during part of the development period to move the 50 percent dot farther away from step one on the gray scale and thus make the middletones print lighter.

The temperature and strength of the developer, the length of development, and the amount of agitation used during development affect the appearance of the halftone negative.

Camera operators sometimes use an extended bump exposure to eliminate the dots in the highlight areas when it is desirable to drop out white. Highlights can also be opaqued out on the negative to produce the same results.

If copy consists of both line and tone, camera operators may make separate line and halftone negatives and *double print* them in register on the plate to produce a combined image, or they may splice one of the negatives into the other. Masks may also be used to produce combination line and halftone work on a single negative.

When a halftone clipping is shot as original copy, the new dot formation might overlap the old and cause a disturbing pattern called moire. To eliminate or reduce moire, camera operators may shoot the clipping as line (if the screen is not finer than 100 lines per inch), or they may angle the copy about 30° off vertical on the copyboard when the exposure is made. A device known as a rescreener may also be used to eliminate moire.

Autoscreen film has a screen pattern built into it during the manufacturing process. Autoscreen film is designed to produce a screened image from continuous tone copy without the use of a halftone screen. This film requires a white-light main exposure and a flash to yellow light. It is not possible to use a bump exposure with this type of film.

CHAPTER 9

STRIPPING AND NEGATIVE CORRECTION

The negatives and/or positives that you produce in the darkroom must be arranged and mounted on a support material (commonly called goldenrod) before the lithographic (offset) plate can be made. They probably will also require touching up or modifications. Any modifications or corrections to negatives or positives are collectively called corrections. These corrections include deleting unwanted images, repairing weak or broken images, and adding images (rules or lines) to the negative. The procedure used for assembling negatives and/or positives in their proper position, mounting (attaching) them to a support material, and making necessary corrections is referred to as stripping.

After the image has formed on the plate, it is difficult to alter it. Therefore, as you do stripping, your first concern should be accuracy. Because the errors you make in stripping will appear on the offset plate, those errors might also end up on your press sheet (the sheet of printed paper produced by your press).

Before you begin stripping, carefully check the instructions that accompany the job. Pay particular attention to the page margins, page locations (as the pages relate to each other), and any other information that applies to the printed image. If any of the instructions are not clear to you, check with your shop supervisor before you begin.

STRIPPING MATERIALS AND EQUIPMENT

You will use a variety of materials and equipment when stripping up negatives and/or positives. All offset printing plates are not exposed with the same type of image. Some plates are exposed from film negatives, while others are exposed from film positives or even a combination of the two. However, the majority of the plates you will be working with will be made from negatives. These plates are known as negative-working plates.

Negative-working plates carry a positive image made by exposing the plate to light through the stripped-up negative. A negative image would be carried on the plate if the exposure were made through a stripped-up film positive. Often a film positive may be stripped in combination with a film negative and exposed to the plate to obtain a negative and positive image on the same plate. When you are working with this last procedure, it is considered combination work.

Since the majority of the time you will be working with film negatives (commonly referred to as negatives), this section will deal primarily with the negative-stripping materials and equipment and their use.

GOLDENROD

The support material on which you arrange (lay out) and attach the negatives in stripping is known as goldenrod. The goldenrod gets its name from its color, which usually is yellow or reddish orange. The goldenrod serves as a mask to prevent light from exposing the non-image areas of the plate. The goldenrod masks the exposure because the emulsion of negative-working plates is colorblind to its semitransparent color.

The type of goldenrod you will normally work with is a coated, 80-pound paper. However, if you are stripping negatives for close register work, goldenrod made of acetate can be used instead of paper because of its increased stability.

A preprinted goldenrod masking sheet that has grid (guide) lines is used for small and medium sized stripping jobs because it saves time (see fig. 9-1). The guidelines allow you to position the negative's image accurately in relation to the plate and the press sheet limitations. As a further timesaving aid, preprinted goldenrod has other information, such as the gripper margins, standard page areas, and centering reference points for various page sizes, printed on it.

You may even preprint your own guidelines on blank sheets of goldenrod with your offset press to meet your particular stripping requirements.

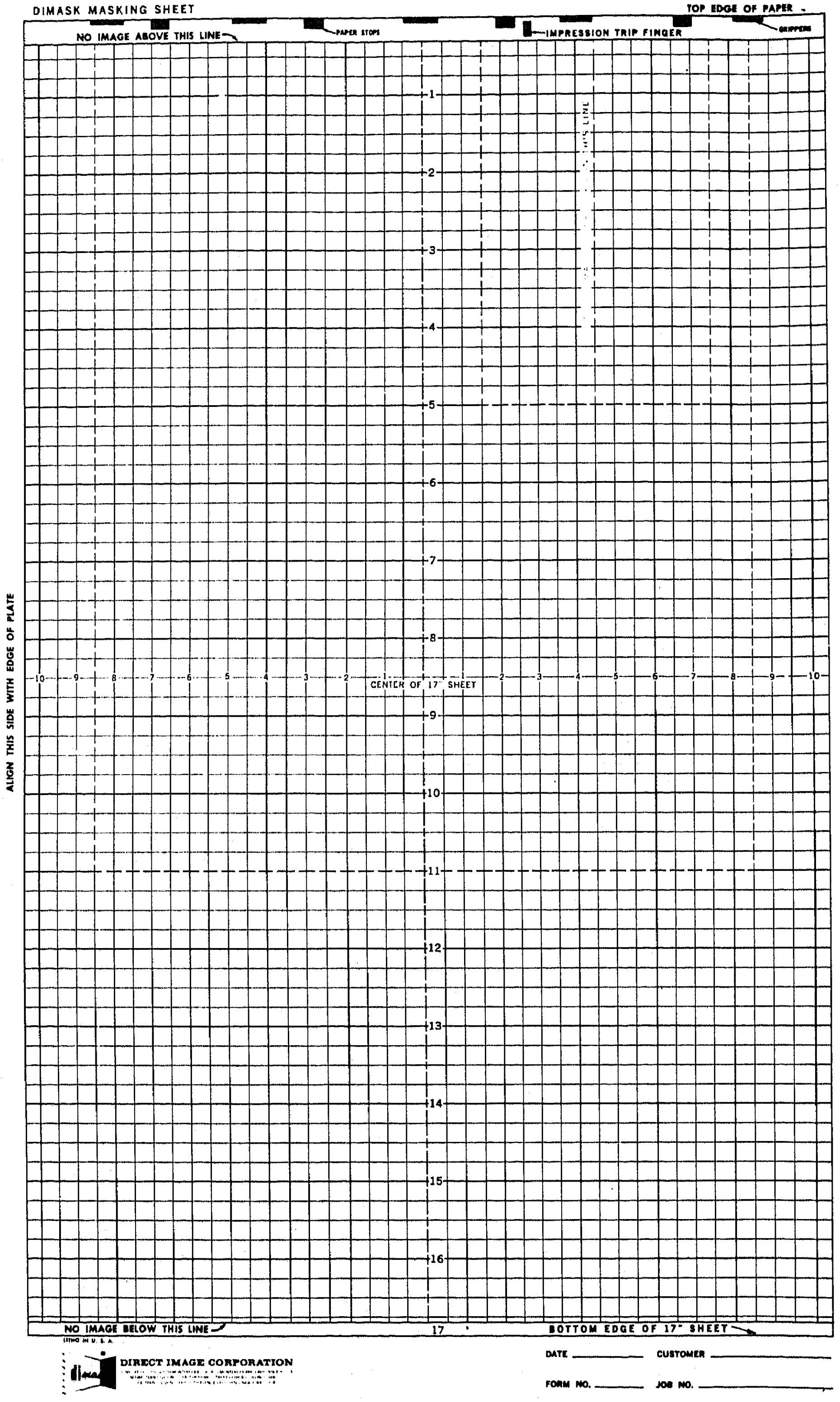


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Figure 9-1.—A preprinted goldenrod masking sheet.

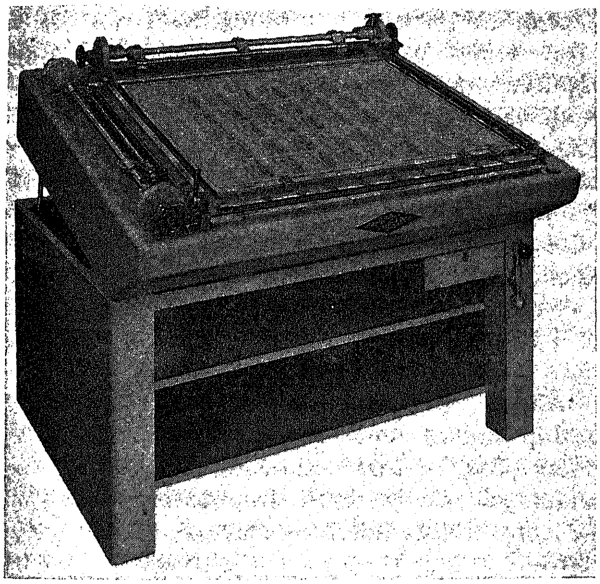

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Figure 9-2.—Line-up table equipped with movable straightedges and spacing controls. A table without these features is called a light table.

These blank sheets of goldenrod are more economical than preprinted sheets. And they can be preprinted for certain special jobs that are printed in your shop on a regular basis. Some examples of such jobs are Welcome Aboard brochures, ship or station newspapers, and family grams.

When you are using goldenrod that is not preprinted, rule-in (draw) the required guidelines. These guidelines will help to ensure that the negatives are accurately positioned. Later in this chapter, you will be shown the procedures for ruling-in guidelines.

LIGHT TABLE

Use a light table for your layout, stripping, and negative-correction operations. The light table has a glass top which is illuminated. The glass is usually frosted on the underside and smooth on the working side.

A line-up table equipped with built-in, movable horizontal and vertical straightedges is shown in figure 9-2. These straightedges are moved into position manually, as shown in figure 9-3. This line-up

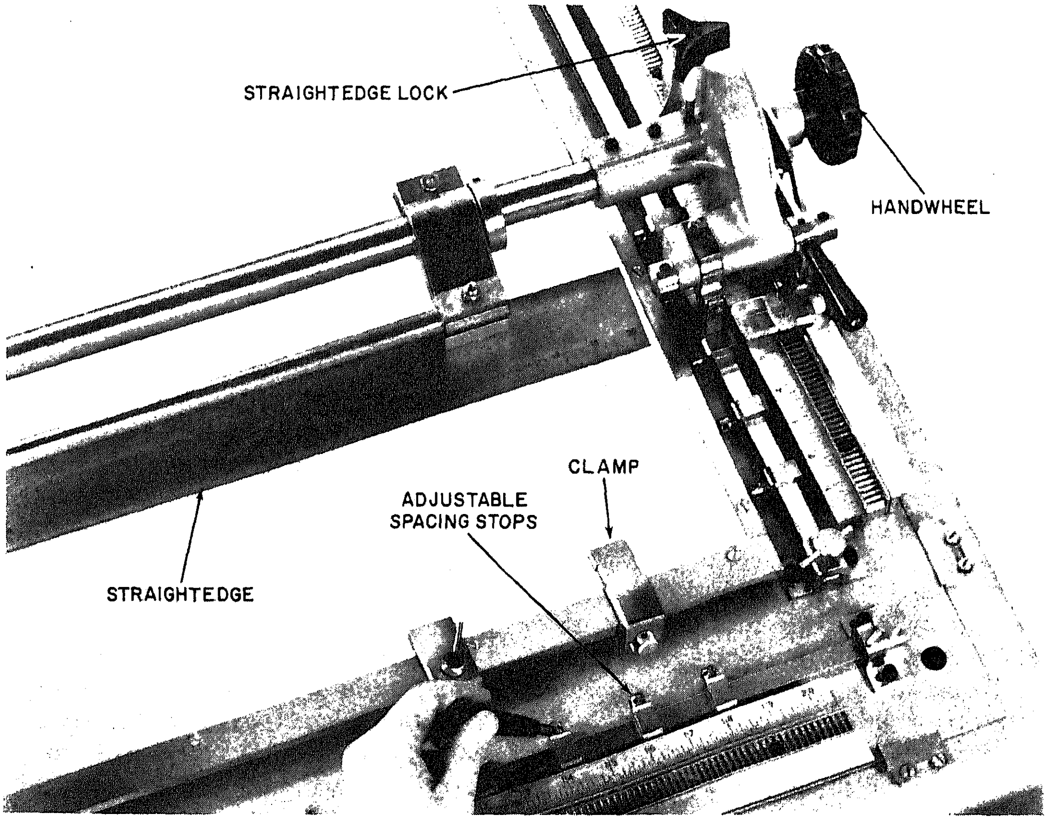

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Figure 9-3.—Close-up view of the movable straightedges and spacing controls of a line-up table.

table could also have a spacing device on it. This built-in spacing device can be set to allow the straightedges to be moved or set a specific distance each time the straightedge is moved. You will find this spacing device very helpful when drawing forms or scribing lines on negatives. However, if your line-up table is not so equipped, you will still be able to do your stripping by using a ruler and a hand-held straightedge.

Before working on a light table, you should check the surface of the glass to see if it is clean. If it is not clean, clean it with a commercial glass cleaner and a soft rag. Because the top of the table is glass, you should avoid placing any heavy objects on it. The only items that should be set on the top of the light table are negatives or positives (film or paper), an extra piece of glass when cutting, and your goldenrod or acetate stripping support material. (These items will not scratch or break the glass.)

If you accidentally spill a liquid on the top of a light table, clean it up immediately because the liquid could seep under the glass and reach the electrical wiring. It could contaminate the straightedges at their gears, or it could contaminate the negatives and the goldenrod.

TAPE

Negatives can be attached to the goldenrod either with clear adhesive cellulose tape or with red or black adhesive tape, which is called lithographer's tape. Lithographer's tape is translucent; it permits visual inspection of the negative over a light table, but blocks out areas of a negative when the plate is exposed. The color of lithographer's tape does not allow light to pass on to the light-sensitive coating of the plate. Of course, the clear adhesive tape is more economical, and it should be used unless you must block out part of the image.

When you are using tape to attach negatives to the underside of the goldenrod, make sure that two pieces of tape do not overlap each other. Otherwise, the double thickness of tape will cause poor contact between the negative and the plate, and this will cause the image on the plate to enlarge or blur.

Always use enough tape to prevent your negatives from slipping out of position or being torn from the goldenrod. A small strip of tape at each corner and one along each edge of a negative will usually be sufficient. But large negatives may require more pieces of tape. When using lithographer's tape to block out areas of the image, you should place the tape on the goldenrod side of the negative. If you have large areas of the image to block out, use scrap pieces of the goldenrod to tape over the image areas to be blocked-out, for economy.

CUTTING TOOLS

A variety of cutting tools, such as razor blades, cutting knives with replaceable blades, and scissors, may be used to cut film, paper, tape, and goldenrod. Always think about safety when you are using cutting tools, as they can cause injury to you or damage to your equipment.

CAUTION

Sharp cutting tools are required for good workmanship, but they can also be dangerous. Care should be taken when you use these tools, because they work best when they are sharp. Never carry cutting tools in your pockets or leave them on the light table where they can be covered and accidentally touched. Discard used blades in special containers, not in waste receptacles.

To open areas of the goldenrod so that the image area of the negative can be exposed to the plate, you must use cutting tools. The openings you make in the goldenrod are referred to as windows. The goldenrod masking sheet with negatives attached and windows is called a flat.

Window openings in the goldenrod are made with either a razor blade or a cutting knife. The cut must be made through the goldenrod only, not into the negative below the goldenrod sheet. Line-copy windows may be cut out freehand, leaving about one-eighth of an inch of space between the cut and the edge of the image. You must remove enough of the goldenrod to ensure that all of the image is uncovered. Remember, if you cut away too much goldenrod, any uncovered defects in the negative will need to be corrected before the flat is ready to be sent to the platemaking section.

When you are cutting windows for halftone negatives, first draw an outline the exact size of the required image area, using a straightedge and a pen. Then, place the straightedge on each side of the outline and cut a window in the goldenrod, making your cuts straight and square. Your cuts must not overlap at the corners, because if they do, unwanted marks may appear at the corners on the plate after exposure. If your cuts do overlap at the corners, however, apply lithographer's tape over the unwanted cut lines as shown in figure 9-4.

When you cut film apart with a razor blade or a cutting knife, cut the film only part of the way through and then bend it so that it will separate along your cut line. Before cutting film all the way through with a razor blade or a cutting knife, place a piece of scrap film or an extra piece of glass under the film on top of your light-table glass. This extra film or glass will prevent the cutting tool from damaging the light-table glass.

CORRECTIONS

As you examine your negatives for needed corrections on the light table, you might discover unwanted image areas. These areas could be covered with lithographer's tape or scrap pieces of goldenrod, as we discussed earlier. However, small or large unwanted image areas on the negative can also be blocked out with a material called opaque.

Opaque is a lightproof paint that is used by the stripper to spot (paint) out pinholes, shadow lines, and other unwanted images on the negative. Two types of opaque are generally used in lithography. One is a water-soluble black opaque, with a pigment of carbon black. This black opaque is generally used for fine-detail work because it is thinner. The other opaque is water-soluble red opaque, which is somewhat thicker and more suitable for covering larger areas. Red opaque can be used to label negatives or to put other identification markings on them because the red color will show up on the black negative.

You should apply the opaque to the negative with brushes like those shown in figure 9-5. The type of brush you select depends on the kind of opaquing necessary. A No. 1 round-tipped brush is ideal for fine-detail work. Smaller brushes, such as a No. 0 or a No. 00, may also be used, but you will seldom need them. On the other hand, you will probably frequently use larger brushes, such as a No. 3 or a No. 5. A No. 8 brush can be used to cover large areas easily. The large, flat, chisel-edged brushes, shown in figure 9-5, are primarily lettering brushes and may be used to apply opaque in long, flat strokes on the negative.

Opaque may be applied to either side of the negative. However, since you will be working primarily with presensitized plates, opaque is generally put on the non-emulsion side of the negatives. This is because the surface of presensitized plates is very smooth, and opaque on the side of the negative that contacts the plate can cause poor contact between the negative and the plate. Also, if opaque must be removed from the negative's emulsion (softer) side, the negative is more likely to be damaged than if the opaque had been applied to the harder, non-emulsion side.

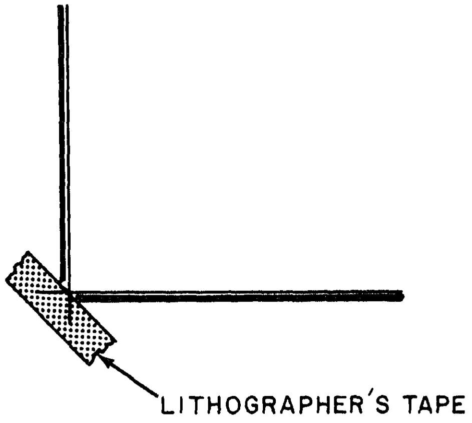

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Figure 9-4.—An over-cut in the corner of a halftone window on a masking sheet is corrected by placing a strip of lithographer's tape over the cuts.

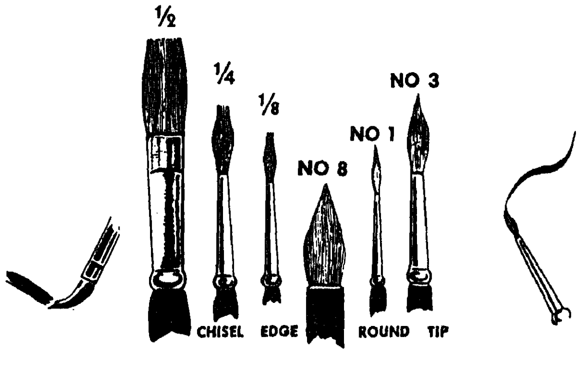

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Figure 9-5.—Various types of brushes used to apply opaque to negatives.

Although you may opaque individual negatives before they are stripped onto the goldenrod, this could be just extra work. Because of the masking effect of the goldenrod, some areas will not require opaquing. Therefore, opaque is generally applied to negatives after they have been stripped onto the goldenrod and the windows have been cut out.

Opaque can be thinned with water until it reaches the proper consistency to flow freely on the negative and yet dry almost immediately. Many lithographers use the cap of the opaque jar as the mixing container. To test the consistency of the opaque, make several short strokes with a brush on a scrap piece of film. When the opaque at the beginning of a 1-inch-long stroke is dry by the time the stroke is completed, the mixed opaque has the correct consistency.

Shadows resulting from ridges on the copy, like those along the edges of paste-ups, show up as transparent lines on the negative and must be masked out.

Spot out pinholes and other small areas of the negative with the tip of the brush. Larger areas, such as shadow lines, should be covered with long, flat, parallel strokes of the brush. Do not apply the opaque in heavy coatings. You can reduce the amount of opaquing required by covering large parts of the negative with pieces of goldenrod paper or lithographer's tape. As you know, this paper and tape will mask out light when the plate is exposed, just as opaque will. When you are masking with goldenrod, tape it securely on the non-emulsion side of the negative. Always keep the edges of the goldenrod mask at least a quarter of an inch away from the needed image area. You can spot out the remaining unwanted image areas of the negative with opaque as necessary.

If you make an error in applying the opaque, correct it immediately; otherwise, you might forget to correct the error. Use a clean, damp cotton swab and wipe outward from the center of the affected area. Keep turning the swab as you work so that you will not drag opaque back into a cleaned area.

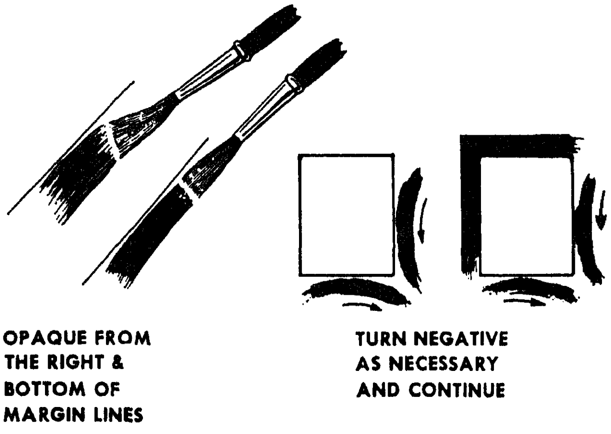
Opaque can also be used to crop halftone negatives and to mask off parts of line negatives that are used in color work.

CROPPING HALFTONES

You can crop halftones by outlining the desired area by ruling a border on the negative with a ruling pen filled with opaque and then painting out the remaining background with additional opaque. The line you draw with the ruling pen should be at least one thirty-second of an inch wide, because it is easier to opaque up to a line if the line is that wide or wider. Work up to the outline by flattening your brush against the negative and drawing it along as shown in figure 9-6. You should work from the right and bottom of your margin lines, then turn the negative as shown in the figure and continue. You can also crop halftones by masking the unwanted image area with goldenrod paper or with strips of red or black lithographer's tape applied to the back (non-emulsion side) of the negative.

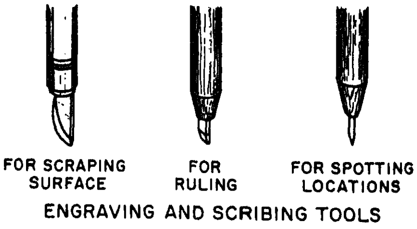
NEGATIVE ENGRAVING

Glare or reflections in your camera can register on the negative as dark areas. These dark areas could appear in your required image area, filling in portions of the image to such an extent that the negative cannot be used. However, you may be able to save the negative by engraving (scribing) it with an engraving tool. The engraving is done by


OPAQUE FROM THE RIGHT & BOTTOM OF MARGIN LINES
TURN NEGATIVE AS NECESSARY AND CONTINUE

57.148

Figure 9-6.—Methods of applying opaque to an outlined area.



57.602

Figure 9-7.—Negative engraving and scribing tools.

scratching the film emulsion away from the base with an engraving or scribing tool. This engraving action could reproduce (replace) the transparent lines lost in the negative. See figure 9-7.

You may also need to engrave lines on negatives to add additional lines or to form boxes and/or borders around the image area. Negative engraving is also done in map and chart work where grid (crosslines) areas are engraved on a master negative and then overprinted on all maps and charts of the same scale.

Engraving and scribing tools, like those shown in figure 9-7, are used to remove film emulsion cleanly. They cut the emulsion in a shaving motion with each stroke. Therefore, your engraving tools must have a sharp, square-cornered cutting edge.

When engraving, you should tape the negative to a hard, smooth, working surface such as the top of a light table so you can examine your work as you go. A soft working surface, such as another negative or paper under the negative you are engraving, will cause the engraving tool to bend, crease the negative, cut through the negative, or cause your lines to be irregular.

Engraving tools are available in various sizes and shapes. There are tools for lettering as well as for scribing single and double lines. Some of these tools are constructed to provide uniform pressure, width, and angle; but in most cases, the handling of the tools depends on the skill of the operator. The cutting quality depends on the sharpness and shape of the point, the angle at which the tool is held, and the amount of pressure applied. A dull engraving tool will furrow the emulsion and produce a ragged line.

The needlepoint tool may be used to engrave a clean line on a negative through a soft emulsion with a hard base. You may also use the needlepoint tool for making marks when you are measuring or for picking up or sliding smaller pieces of negatives into position.

To scribe lines on a negative, you should square the negative to the light table and tape it down, emulsion side up. If the negative requires opaquing, you should apply the opaque to the emulsion side of the negative before starting to scribe (rule).

If your shop is equipped with a line-up table, find the location for the required lines by moving the metal straightedge along the scale on the side of the table. Also, if your table is equipped with the automatic spacing device at the end of the straightedge, then this device is ideal for ruling a series of lines. This spacing device can be set to allow the straightedge to be moved a specific distance each time. Therefore, each time the straightedge is moved and the line is scribed, the lines will be equally spaced.

If you need to scribe lines on the negative but do not have a line-up table, square the negative, emulsion side up, and tape it to the top of the light table. Then mark the location of each line to be drawn with a pair of dividers or an engraving tool and a steel ruler. If a copy of a previously printed form showing the location of the lines you need to scribe is available, use it for locating the positions of your lines. Square the printed form and tape it beside the negative. Then, position the straightedge on the printed line of the form and scribe corresponding lines on the negative. It is a good idea to test your engraving tool in the margin of the negative before you begin scribing on your negative. The test marks can be opaqued out later, if necessary. If your scribed lines are uneven in length, you can even them up by opaquing or by applying strips of lithographer's tape over the unwanted ends of your scribed lines on the non-emulsion side of the negative.

STRIPPING A FLAT

Since you are required to work almost entirely with negatives and goldenrod paper, you will need a complete understanding of the goldenrod stripping process. This section will outline the procedures used for stripping negatives on plain, unprinted goldenrod paper serving as the negative's layout masking sheet. If your shop uses preprinted goldenrod, the procedures are basically the same; however, you will not need to rule-in the required guidelines on the goldenrod. Once you understand the process of stripping on plain goldenrod, you will find that using preprinted goldenrod sheets will simplify your work.

PLANNING THE LAYOUT

Before you begin stripping, you should carefully read the instructions that accompany each job. If the job consists of multiple pages, there probably will be a master layout or dummy that you can use as a masking sheet layout guide. But for many jobs, planning the masking sheet layout will be your job. In either case, you must accurately draw guidelines on the goldenrod layout sheet so that the negatives will be properly aligned and positioned.

Check each negative for correct size and quality and then arrange them in their proper sequence. The negatives should also be trimmed with a hand paper cutter or scissors, leaving at least one-half of an inch around the image areas. If any of the negatives are to be spliced or butted together, or if any of the pages are to bleed, you will have to adjust the trimming accordingly. (A page is said to bleed when its image runs off the edge of the paper.) Negatives that are to bleed are best trimmed after they have been positioned on the goldenrod, because then you can actually see how much of a trim is required.

One of your primary considerations when you are planning a layout is the size of the press to be used to run the job. If your shop has only one press, this will present no problem, but if you have presses in two or more sizes, check with your shop's LPO if the press size is not indicated in your instructions. If the job requires a long press run, it may be better to set up the plate to run the job more than one-up on a large press. As you will see later, you can do this by making several negatives and stripping them on the same flat or by making one negative and exposing it in different locations on the plate.

Of course, if your press run is short, the extra negative shots and the extra stripping time involved may not make it worthwhile to print a page more than one-up. Then it would be better to run the single page on a smaller press. If your job requires close register, that also may affect your selection of press, because the larger presses often register better than the smaller presses. Pages of large solids and halftones may need to be stripped to run on larger presses.

It is best to strip large solids and halftones on the goldenrod so that their images are along the gripper and at the center of the goldenrod layout. Close register work should also be stripped along the gripper and in the center of the goldenrod layout.

RULING THE LAYOUT

Once you have planned the layout for your negative, you are then ready to start ruling (drawing).

- Select a sheet of goldenrod paper the size of the offset press plate you will be using. If the paper is ragged or cut crooked, trim it with a cutting knife or razor blade, using a steel straightedge as a guide. To trim the goldenrod sheet so that it is square, tape the sheet to the light-table top and use a T-square to draw lines around the goldenrod that are parallel to the sides of the table.

- Cut away the unwanted trim from the goldenrod with your cutting tool, using a steel straightedge as a guide. As you trim the goldenrod, be careful not to move the straightedge or the paper so your new edge will not be ragged or crooked. Remember that after the goldenrod is trimmed, it must still be big enough to cover the press plate.

- Square the goldenrod to the top of the layout table by aligning one of the long sides of the goldenrod with a T-square.

- Tape the goldenrod sheet to the layout table so that it will remain squared.

When indicating the points of your measurements on the goldenrod, you should use a thin, short line. Some strippers make precise marks by punching the goldenrod with a needlepoint tool. It is helpful to circle the pinholes so they can be seen readily. These holes should be covered later with lithographer's tape to prevent them from being exposed on the plate. Measurements should be made with a steel ruler, because it is more accurate than wood or plastic rulers. If your ruler does not have a space between the zero (the normal starting point of measurements) and the left end of the ruler, then you should use the 1-inch mark as the starting point for your measurement, because it is difficult to locate the zero point. Most strippers mark the goldenrod sheet with a black or blue ball-point pen. It is difficult to see the lines on goldenrod when a hard pencil point is used, and lines made with a soft pencil tend to spread in width.

Gripper Margins

As you draw the layout on each goldenrod sheet, allow space for the plate and press paper (sheet) gripper margins. Since these margins vary from one press to another, you will have to know the specific margins for each press in your shop. NOTE: Information on margin measurements for each press can be found in the operator's manual. There cannot be any printing image stripped into these margin areas.

The plate gripper margin is the narrow strip along the leading (gripper) edge of the plate and along the trailing edge (the edge that is horizontal to the leading edge). This gripper margin area drawn on your goldenrod layout represents the area where the clamps on the plate cylinder grasp the plate when it is on the press. Because your printing jobs are generally stripped into position along the leading edge of the plate, it is not necessary to mark the trailing edge of the plate on the goldenrod layout sheet unless the image area is exceptionally large.

The paper gripper margin is the amount of space required along the leading (gripper) edge of the paper. Its purpose is to show the margin required for the press grippers to grasp the paper and pull it through the press.

After you determine the required gripper margins for your layout, draw lines along the designated goldenrod layout sheet edge. Some strippers draw solid lines to indicate each of the two margins, while others use a dotted line to indicate the paper gripper margin. You need to draw only one line if you have combined the distance of both margins.

Other Reference Lines

In addition to the gripper margin lines, you should measure the goldenrod sheet and draw a vertical centerline from the gripper margin line. This centerline will be used as a reference point for centering images in your layout.

Most strippers also draw in lines to show the outline of the press sheets on the goldenrod layout sheet. If the finished printed sheet is to be trimmed after it is run on the press, you should draw additional lines indicating the trim size of each sheet. The number of reference lines you include on the goldenrod depends on the nature of the job and your own preference. However, you should include all reference lines needed so that you and the platemaker, the press operator, and the bindery personnel can do the job.

Some strippers like simple goldenrod layout drawings, while others prefer or need more complex layouts. Until you gain experience, it would be a good idea to use as many reference lines on your goldenrod layout as possible to ensure the accuracy of your stripping.

MAKING A SIMPLE LAYOUT

Study figure 9-8. It shows the actual steps involved in producing a simple flat.

For the purpose of this example, which is flat production, assume that you have a job that calls for a letterhead. The copy has been shot and the negative is useable. The instructions accompanying the job state that the image is to be centered, side to side, on an 8- by 10 1/2-inch sheet. The head (top) margin, which is the space between the top line of the copy and the top edge of the sheet, is five-eighths of an inch.

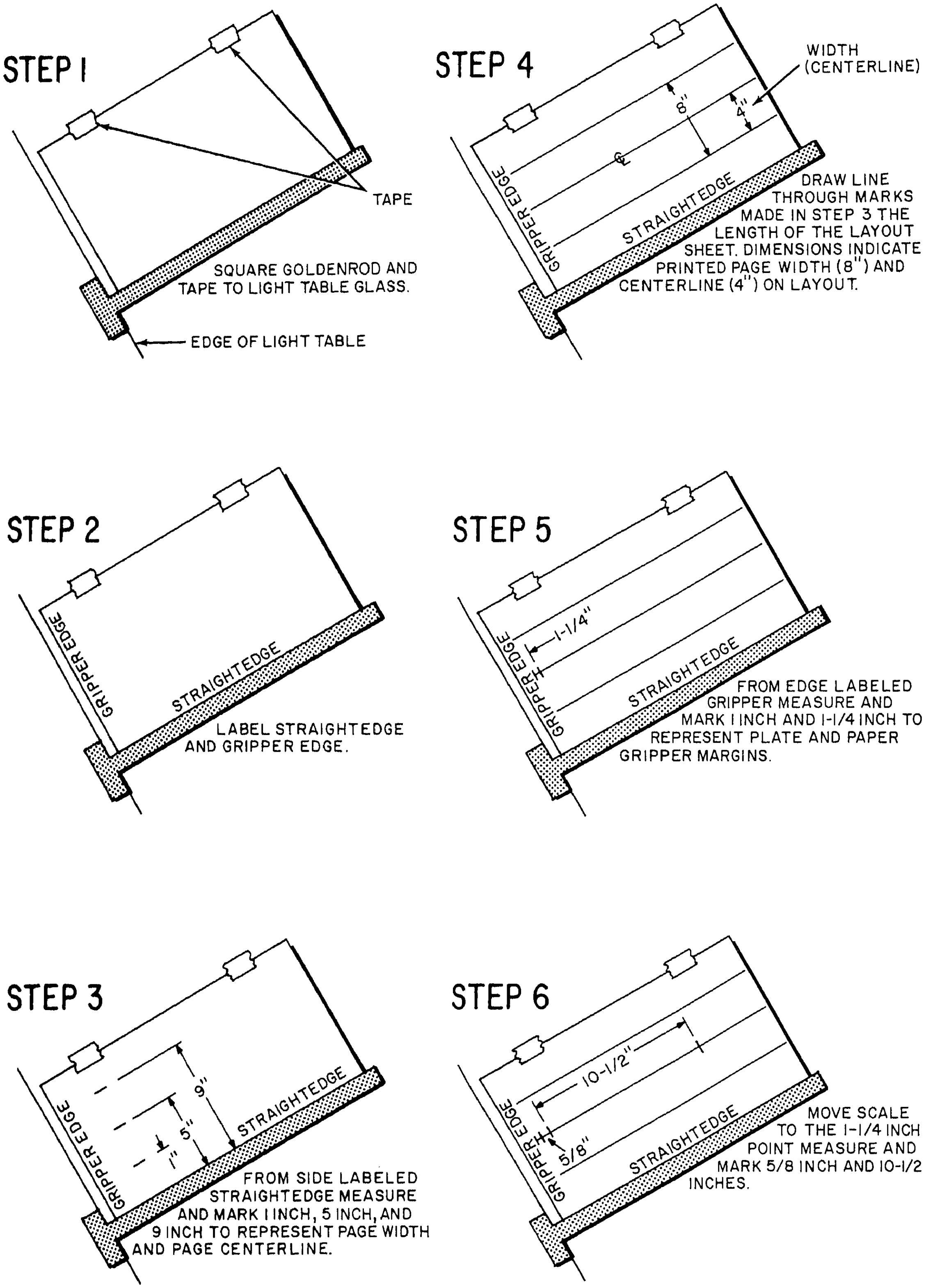
The job will be printed on a press, using a plate needing a gripper margin of 1 inch. The required paper gripper margin is one-fourth of an inch.

The information about the job is then measured and drawn on the goldenrod layout sheet as shown in steps 1 through 7 of figure 9-8. After you have completed these seven steps, you are then ready to position and attach (strip in) the negative into its proper position as shown in steps 8 through 11 of figure 9-8.

For this flat, the negative image must be centered from left to right. This means you must place the center of the negative image on the centerline you have drawn on the goldenrod layout sheet. To find the image centerline, measure the longest line of the image and mark the negative at half the measured distance on the emulsion side of the film. Then, working over a light table, line up this mark with the centerline on the goldenrod. The top of your top line of typed material must be on the headline, which is drawn at five-eighths of an inch from the line representing the top edge of your page. When you have positioned your negative to meet these two requirements, then you are ready to tape (tack) the negative to the underside of the goldenrod.

After you tack the negative in position, turn the flat over and finish fastening it down securely with additional pieces of tape. As you apply the tape to both the negative and the goldenrod, make sure that the tape is never placed closer than one-fourth of an inch to the image area. Tape that is too close to the image area could prevent the negative from making complete contact with the plate during exposure.

Next, turn the flat over to its front side and cut an opening (window) in the goldenrod to expose the image area of the negative. As you are cutting the window in the flat, use just enough pressure on your cutting tool to cut through the goldenrod without cutting into the film. The window should not be cut larger than the size needed. When you are cutting the window of the flat, uncover only the image area of the negative. If the window is cut too large, you will have to opaque the extra openings, pinholes, or other defects in the negative.



STEP 1

SQUARE GOLDENROD AND TAPE TO LIGHT TABLE GLASS.

STEP 2

LABEL STRAIGHTEDGE AND GRIPPER EDGE.

STEP 3

FROM SIDE LABELED STRAIGHTEDGE MEASURE AND MARK 1 INCH, 5 INCH, AND 9 INCH TO REPRESENT PAGE WIDTH AND PAGE CENTERLINE.

STEP 4

DRAW LINE THROUGH MARKS MADE IN STEP 3 THE LENGTH OF THE LAYOUT SHEET. DIMENSIONS INDICATE PRINTED PAGE WIDTH (8") AND CENTERLINE (4") ON LAYOUT.

STEP 5

FROM EDGE LABELED GRIPPER MEASURE AND MARK 1 INCH AND 1-1/4 INCH TO REPRESENT PLATE AND PAPER GRIPPER MARGINS.

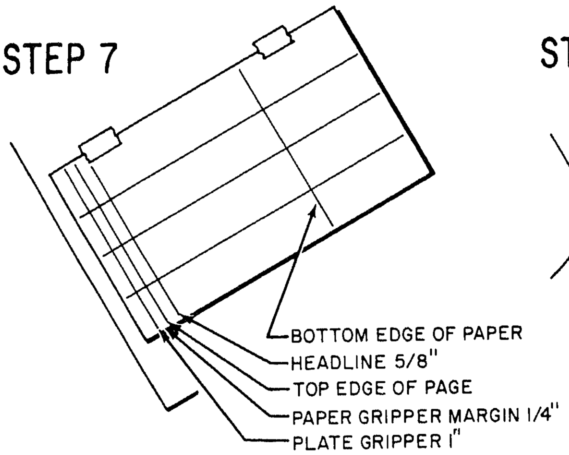
STEP 6

MOVE SCALE TO THE 1-1/4 INCH POINT MEASURE AND MARK 5/8 INCH AND 10-1/2 INCHES.

57.735

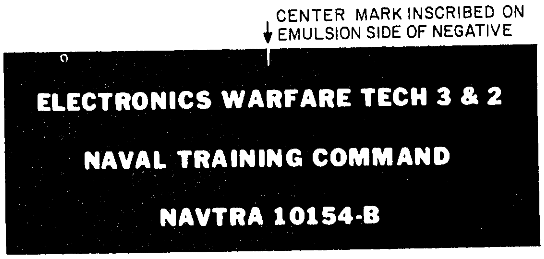
Figure 9-8.—Layout and stripping procedures for a simple flat.

STEP 7



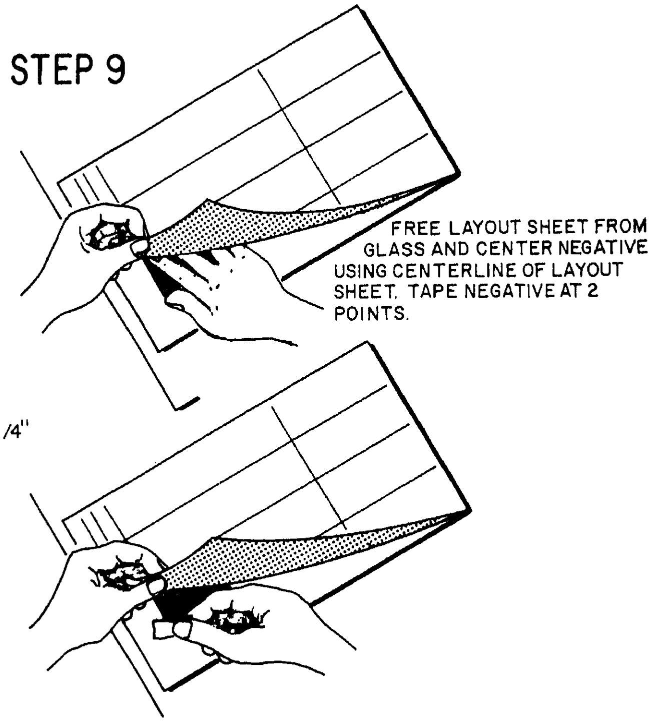
DRAW LINES THROUGH THE MARKS MADE IN STEP 6 THE WIDTH OF THE LAYOUT.

STEP 8


CENTER MARK INSCRIBED ON EMULSION SIDE OF NEGATIVE
ELECTRONICS WARFARE TECH 3 & 2
NAVAL TRAINING COMMAND
NAVTRA 10154-B

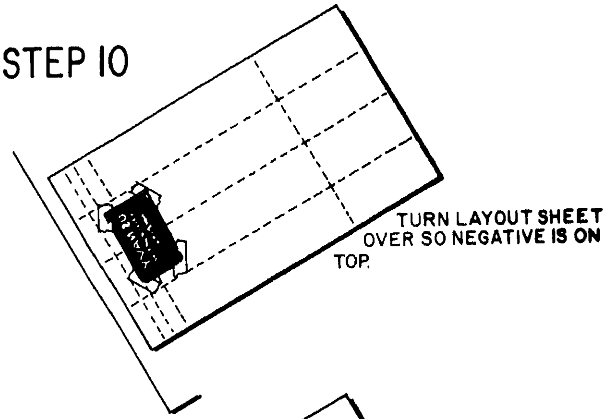
TO INDICATE THE CENTER POINT OF A NEGATIVE, MEASURE THE LINE TO BE CENTERED ON THE LAYOUT AND PLACE THE CENTER MARK OUTSIDE THE IMAGE AREA.

STEP 9



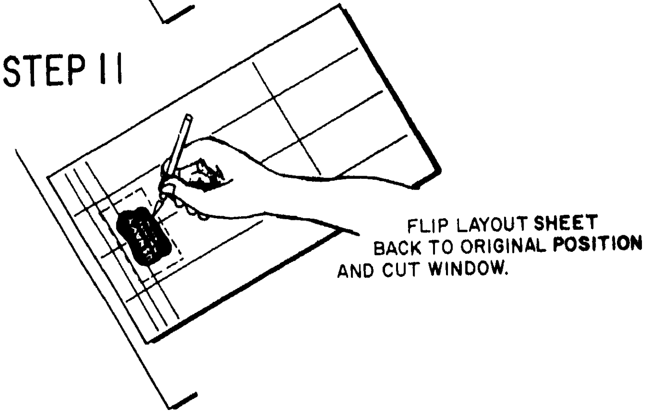
FREE LAYOUT SHEET FROM GLASS AND CENTER NEGATIVE USING CENTERLINE OF LAYOUT SHEET. TAPE NEGATIVE AT 2 POINTS.

STEP 10



TURN LAYOUT SHEET OVER SO NEGATIVE IS ON TOP.

STEP 11



FLIP LAYOUT SHEET BACK TO ORIGINAL POSITION AND CUT WINDOW.

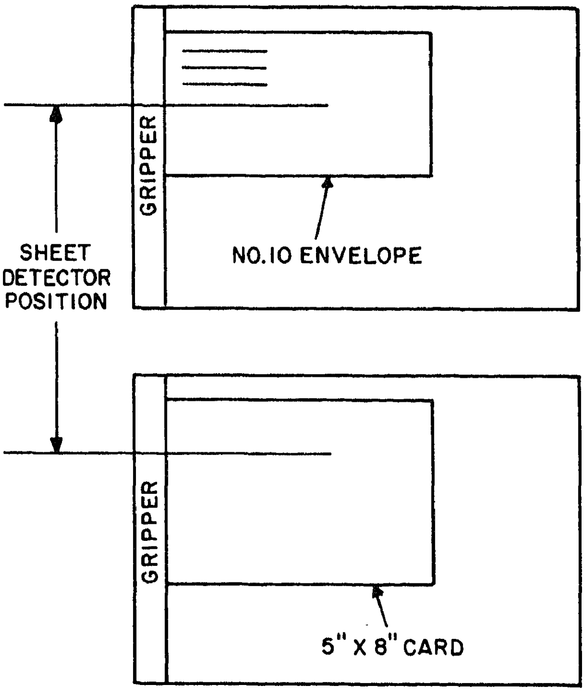
57.735

Figure 9-8.—Layout and stripping procedures for a simple flat—Continued.

If you make a flat with a lot of windows, it will lose its rigidity because of all the goldenrod that was cut away. However, if the stripped negatives are not halftones, you can restore some of the rigidity by placing clear tape on the front side of the flat, extending the tape over the negative. Clear tape placed over the image area of a line negative will not ordinarily interfere with the plate image quality.

STRIPPING FOR NARROW WIDTHS

When you use an offset press, the press sheet travels into the printing unit from the paper stack. Just before each press sheet enters the printing unit, it activates a device known as the sheet detector or impression trip. If a sheet fails to feed from the paper stack during the press run, the sheet detector will not be activated. This, of course, will prevent the blanket from contacting the impression cylinder. Otherwise, without the press sheet in the printing unit to receive the image from the blanket, the image would print on the surface of the impression cylinder. Then the next press sheet fed into the printing unit would be printed on both sides of the sheet.



57.607X

Figure 9-9.—Off-center stripped position for narrow-width sheets.

The location of the sheet-detecting device will vary on some presses. You will find presses that have this device off center on the feedboard. Therefore, narrow-width jobs (jobs printed on narrow press sheets) must have their images stripped off center on the flat, as shown in figure 9-9. Then, the paper stack is loaded into the press feeder, which is also off center to match the image position. These actions will ensure that the narrow-width press sheet will contact the sheet detector on your press and that the image will be correctly positioned on the sheet.

MAKING FLATS FOR LARGER PRESSES

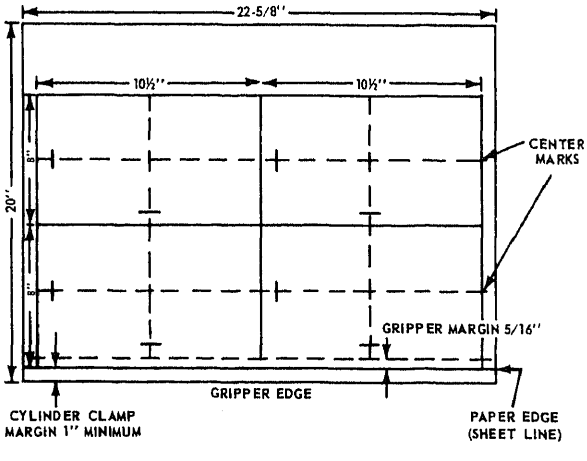
When you make a flat for a larger offset press, the procedures are essentially the same as those used to make the smaller, simpler, one-page flat.

After you draw the basic reference guidelines on the goldenrod layout sheet, indicating the press sheet outline and the plate gripper and paper gripper margins, the layout sheet is divided into fourths with additional guidelines. See figure 9-10.

You can, of course, add more pages by drawing other lines to divide the page areas into eighths or whichever page multiple is required.

Now draw the guidelines for each page onto the goldenrod to indicate the side and head margins of the individual pages.

Once you have drawn these lines on the goldenrod, the negatives are positioned, one at a time, underneath the goldenrod and attached to it with tape. When you have the negatives



57.153

Figure 9-10.—Goldenrod layout for four-page job to be run on a large press.

securely taped to the flat, windows are cut in the goldenrod to expose the image area of each individual negative.

OTHER STRIPPING TECHNIQUES

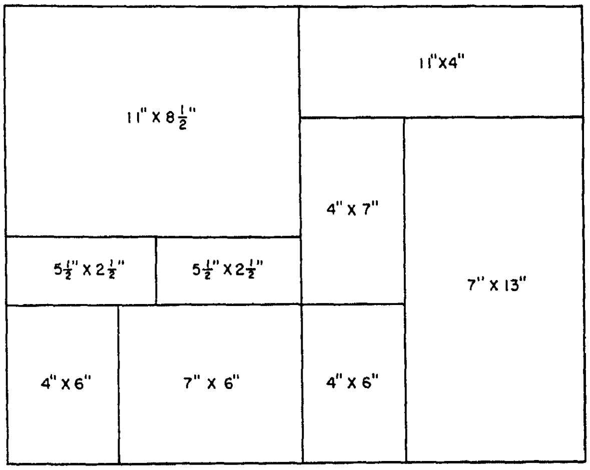
All strippers do not use the same stripping techniques. Instead of tacking pieces of tape underneath the negatives and goldenrod, some strippers position the negatives under the goldenrod and then cut two small holes in the goldenrod. One hole is cut above the negative and in an upper corner of that image; then another hole is cut in the opposite lower corner above the same negative. After these holes are cut and with the negative still in position, place a strip of tape over each hole to tack the negative to the goldenrod. After all the negatives have been tacked in place, turn the flat over and finish securing the negatives to the goldenrod with additional pieces of tape before cutting the windows in the goldenrod. Some strippers do not need to secure the negatives on the back of the goldenrod after tacking them. The windows can be cut after tacking the negatives. Then place lithographer's tape on the window edges of the goldenrod and the non-emulsion side of the negatives. This eliminates taping the emulsion side of the negative (the side that normally should contact the presensitized plate) and allows for better contact between the plate and the flat during platemaking exposure.

GANG LAYOUTS

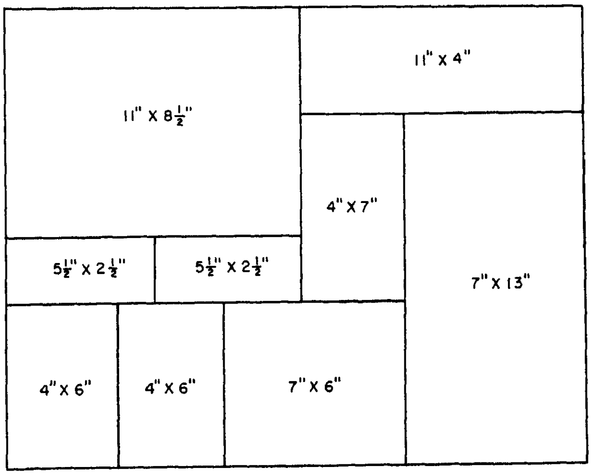
You can save paper and/or press running time by stripping a number of separate jobs for the same press sheet and then cutting the jobs apart later in the bindery. This is referred to as a gang layout. Gang layouts can be used if all of the jobs are to be run on the same kind of paper and in the same color of ink, if all of the jobs require the same or approximately the same number of copies, and if all of the jobs can be cut out of the press sheet properly.

Do not combine into one flat two or more jobs that require a different number of copies unless you can strip the jobs so that they can be completed with the same number of press impressions. For example, if one job requires 2,000 impressions and another job requires 4,000, you could, perhaps, strip these two jobs for the same press run. You would strip one negative for the first job and two negatives for the second job. After you produce a plate from your flat, 2,000 press impressions will then produce the 2,000 required copies of the first job and 4,000 copies of the second job after you cut the sheets out of the press sheets.

When you use a gang layout of jobs of different sizes, the jobs should be arranged at staggered locations or with the heads of the jobs in different directions. First, you should make a rough sketch showing the shape, trim size, location, and head direction of each job as they will be stripped into the flat. Check your sketch to make sure that the jobs can be cut out of the press sheet. Notice that in figure 9-11, jobs that are improperly positioned are impossible to cut apart without destroying one or more of the jobs.



RIGHT

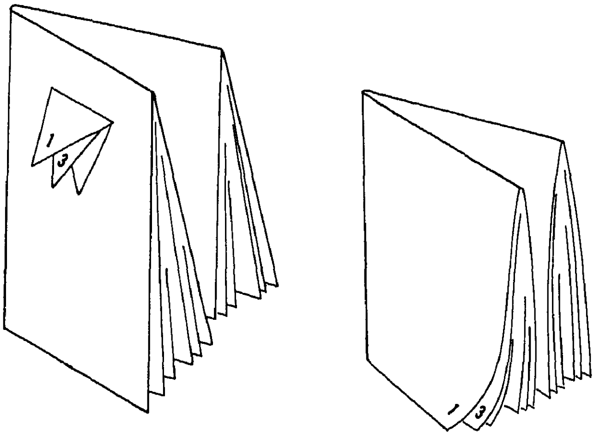


WRONG

57.609

Figure 9-11.—Gang or combination layout.

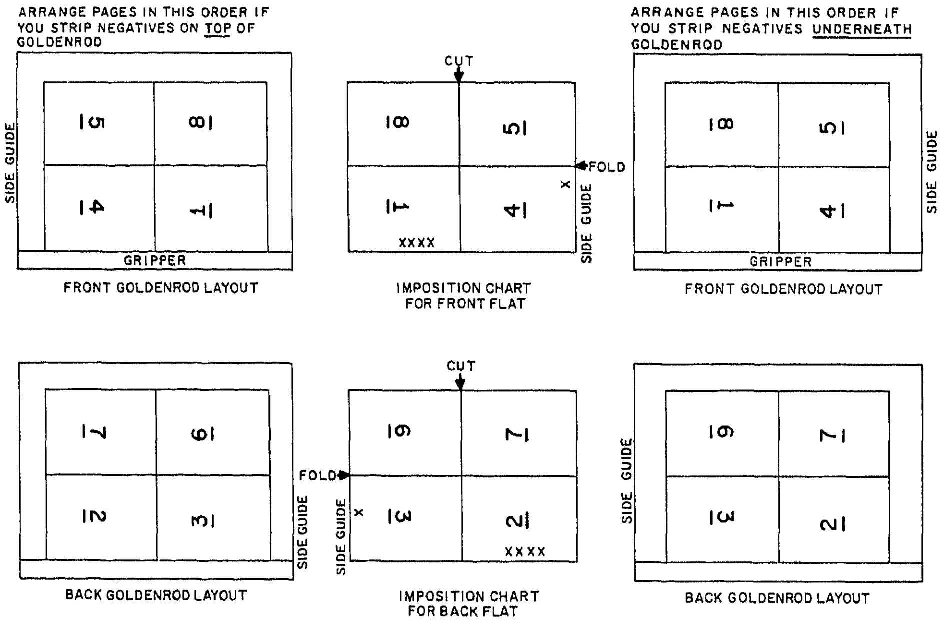
The rough sketch you made before you began stripping can also be used in the bindery to save planning time in determining the minimum number of cuts needed to separate the jobs on the press sheet. Many times several sketches should be made to determine which layout will require the least number of bindery cuts to separate the jobs from the press sheet. You might cut pieces of paper to the size of the various jobs and move these papers around until you find the best arrangement for them. This last method is somewhat easier and less time-consuming than drawing a series of sketches.



57.610
Figure 9-12.—Two methods of preparing an imposition chart.

When you are actually ready to prepare the gang-layout flat, keep in mind that the procedure is similar to the layout guideline drawings discussed earlier in this chapter. First, draw in the paper gripper and plate gripper lines. Next, indicate the position of each job by drawing its outline on the goldenrod. If a job is to be exactly centered, or if the edge of a job coincides with the vertical center of the flat, you should draw in the outline of these jobs first. Otherwise, it is easier to start drawing your outlines at one outside corner along the gripper edge of the goldenrod.

When jobs are ganged on the press sheet, it is likely they will require additional trimming, even after they are cut from the press sheet. If the image is to bleed (run off the edge of the sheet), for example, you must allow not only for the cut line but also for additional trimming. Extra



57.612
Figure 9-13.— Sheetwise imposition for an eight-page booklet. If the negatives are stripped on top of the layout sheet, the flat is turned over when the plate is exposed. Therefore, the negatives must be reversed on the goldenrod layout as shown on the left. When the negatives are stripped under the layout sheet, their position is identical to the position of the pages on the imposition chart, as shown on the right.

image must be printed and later trimmed off to get the bleed effect. Allow extra space for the job so that the image will not run into the margins of the adjoining job. A double trim allowance must also be included if any of the image is to bleed along the gripper margin.

IMPOSITION CHARTS

When you are stripping negatives for bookwork, it is necessary to prepare an imposition chart to make sure the pages are laid out in the proper order and position. An imposition chart is simply a blank press sheet folded down to an approximate finished page size with page numbers (folios) to show the proper order of pages (see fig. 9-12). Many lithographic shops keep a supply of machine-folded blank sheets on hand to use in preparing imposition charts.

After the folios have been marked on the imposition chart (sheet), you should use it as a guide in laying out the pages on the goldenrod sheet. When negatives are stripped *underneath* the goldenrod layout, their positions should correspond exactly with the folios of the imposition chart. However, because of the large size of some flats and the difficulty encountered when they are flipped over to tack the negatives in place, strippers sometimes work from the back (second side) rather than the front of the flat. When working with this second side, you must remember that the flat will be turned over so that the emulsion side of the negatives will contact the plate when the plate is exposed. When the flat is turned over, the position of the negatives is reversed. The negatives on the left side of the flat will appear on the right side, and vice versa. Therefore, when you are working from this second side, the order of the pages must be the reverse of the order in which they appear on the imposition chart. See figure 9-13.

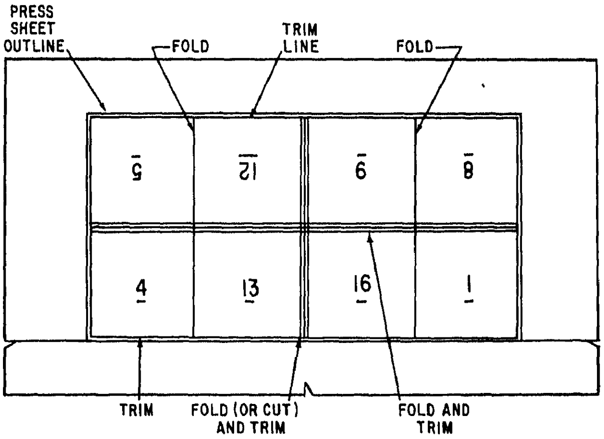
BOOKWORK IMPOSITIONS

The order in which negatives or positives are arranged on the flat is termed *imposition*. Impositions for bookwork are similar to those required for other types of layouts, with two important exceptions: (1) the pages must be arranged in a specific order so that they can be backed up properly and will fold down in sequence and (2) the margins must be calculated to include a double trim on all inside edges except the binding edges of the pages.

Since for most bookwork the individual pages you will be stripping will be the same size, a translucent master layout should be made on acetate to help you to prepare the flats for bookwork. With this translucent master layout, you need to make your measurements only once. Then the translucent master layout sheet can be placed on your light table, and you can trace the guidelines onto the other required goldenrod sheets.

The layout procedure for bookwork is similar to that used in preparing other types of flats. You should draw in your basic reference guidelines (plate gripper and paper gripper margins, centerlines, and so forth) first. Remember that the pages will be trimmed on two or three sides after printing. Notice in the layout shown in figure 9-14 that many trims (or cuts) have been indicated for the finished press sheets. Notice also that one of the trim lines is indicated at the gripper edge of the press sheet. If the page size of your book is small, it is possible to omit this trim; but if the page size is large, it is generally necessary to trim along this edge. Your finished job will look better if this trim is made, because if the gripper edge of your press sheet is not trimmed away, it will be the edge of the finished job.

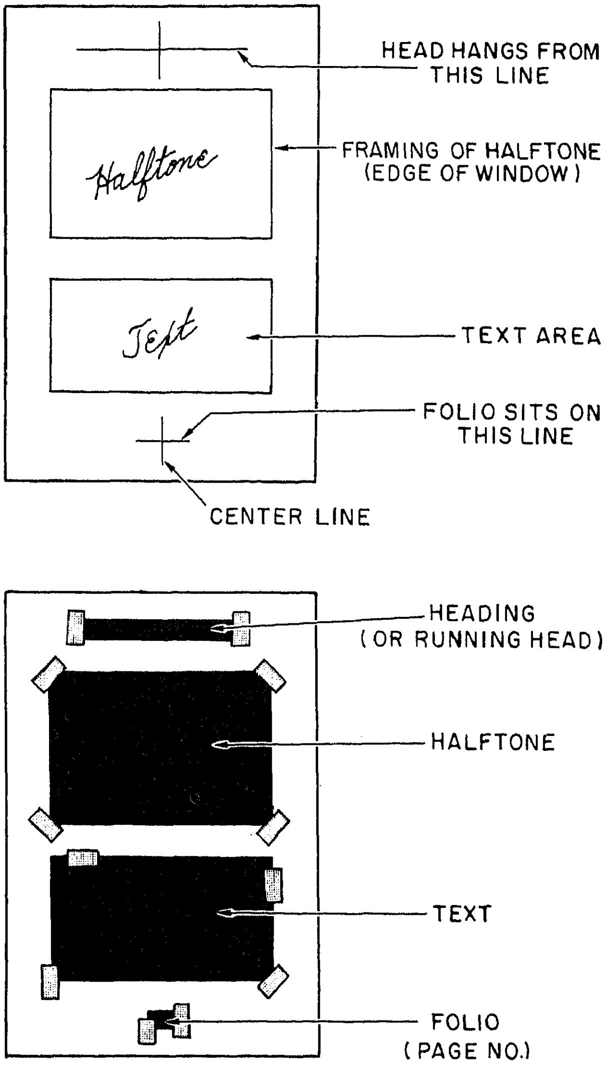
When a book contains a large number of pages, several groups of pages (signatures) may be inserted one inside the other for saddle stitching in the bindery. You will also find that the image area of the inner pages moves out (creeps or pushes away from the bind margin) approximately one thirty-second of an inch in



57.614

Figure 9-14.—Layout imposition showing trim and/or fold margins.

each 16-page signature. This means that the outer margin will be progressively narrower on the inner pages of these thicker books. You can remedy this pushing out by allowing less margin along the inner (gutter) and more margin along the outer margin of the pages about every third signature. If you are not sure about the amount of image pushing out, you can determine it by collecting the total folded, saddle-stitched signatures you will have in your book. Then stack these signatures as they will be arranged in the book. Measure and mark the required inner margin at the top and left of the first sheet. Next, extend your mark straight down the stack of folded and stitched signatures.


HEAD HANGS FROM THIS LINE
Halftone
FRAMING OF HALFTONE (EDGE OF WINDOW)
Text
TEXT AREA
FOLIO SITS ON THIS LINE
CENTER LINE
HEADING (OR RUNNING HEAD)
HALFTONE
TEXT
FOLIO (PAGE NO.)

57.162

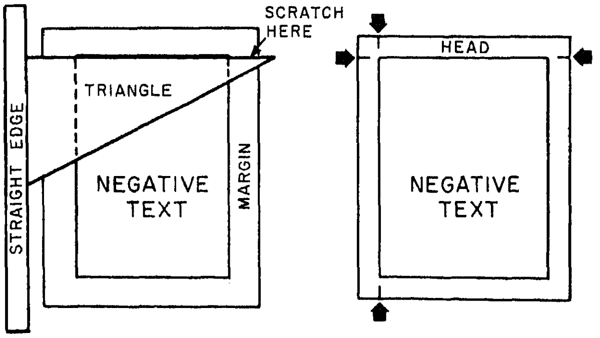
Figure 9-15.—How guidelines are used to aid in positioning

Now when you separate these signatures and measure the inner margins of all the pages of the book, you will have determined the amount of inner margin change throughout your book. These inner margin measurements will be used now to make your imposition layouts.

Frequently, a page of a book will consist of several small negatives, and you will strip the page by placing the negatives in their proper positions on the goldenrod layout sheet. The illustration at the top of figure 9-15 shows how you can draw in guidelines on the flat to aid in positioning the various negatives. The illustration at the bottom of the figure shows the flat for the same page after the four negatives have been stripped in. Crossmarks, like those shown in figure 9-15, are often used to indicate the location of page numbers (folios) for the pages.

Since the pages of composed text in bookwork are generally of the same image width, most strippers will strip to the margins of text rather than to image-center marks. Figure 9-16 shows how to scribe (scratch) a negative by using a straightedge and placing a triangle along the text margin and scratching marks in the emulsion along the edges of the negative. These marks can then be aligned with corresponding lines drawn on the goldenrod layout sheet.

Each finished flat and its corresponding plate should be marked so they can be identified. The first front flat should be marked F-1; the second front flat should be marked F-2, and so on. The first back flat should be marked B-1; the second back flat should be marked B-2, and so on. This is done, of course, only when different plates are required—one for the running of the fronts and another for backing up the job.



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57.159X

Inscribed or photographed lines or crossmarks, which are commonly called tick marks, are often used on flats to indicate the fold or trim lines. Tick marks should be placed on the flat so that they will print on the press sheet but outside of the finished page margin. When the tick mark is located at the junction of two fold lines in the center of the flat, the crossmark is called the center fold tick mark.

You can make tick marks directly on your flat simply by cutting into the flat, using a cutting knife or razor blade along with a steel ruler or straightedge. Some strippers create their tick marks on pieces of trimmed, exposed and processed film. To create tick marks in this manner, you should cut the exposed and processed film into 1/2-inch-wide strips and then scratch (scribe) a hairline or a column of crossmarks down the center of each strip. Another method of producing tick marks is to draw a series of hairlines and columns of crossmarks to use as original copy. This original copy is then photographed with your process camera, and a negative is produced. The negative is cut into 1/2-inch-wide strips, with the tick marks in the center of each strip. As more tick marks are needed, you can cut the strips into square pieces having a 1/2-inch side. The 1/2-inch squares are convenient for stripping on your goldenrod flat.

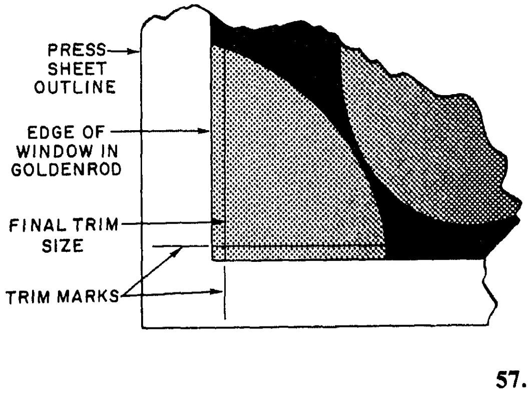
The tick marks are reproduced on the offset plate by cutting small windows in the flat to expose the scribed lines or crossmarks, just as the image area of the negatives is exposed.

Stripping Bleeding Images

If the image is to bleed (run off the finished page edge after the job is trimmed), the windows cut in the flat should extend one-eighth inch beyond the trim line (see fig. 9-17). If the finished image is to bleed into the gutter (center margin) in bookwork, the window should be cut so that the image area will end exactly on the centerline where the sheet is folded. If part of the image is to be printed on one page and part of it on the facing page, you should allow the image to extend through the gutter across both pages if the pages will appear in the center of your book. If the pages with a bleeding image are not in the exact center of the book, the negatives are likely to be

tions. In fact, the bleeding image negatives may even be located on separate flats. In that case, you should still use only one negative for your bleeding image, since it is difficult to match the parts of the image area if you make two separate negatives. Cut the window for the bleeding image in the space allotted for that page in the flat. Be sure to allow the image to run into the gutter to the centerline, where the sheet will be folded. Now you cut a similar window for the image on the other page which will be across from the first page. You can then either cut the negative in the bleeding image area and strip part of it under one window and part under the other, or you can strip the entire image in place under the first window. If you choose the latter stripping method, then you will have to mask off the remainder of the flat while making the first exposure. Move the negative with the bleed image to the second opening and strip it in so that the part of the image required for the page can be exposed. Mask off the remainder of this flat and make the second exposure. You now have two matching exposures from the same negative. As a final operation, you should mask off the two bleeding image windows and make another exposure for the other images that will go on the press sheet.

When you are doing bookwork, it is sometimes necessary to cut and trim the pages from the press sheets after the job has been run on the press. If the job involves a bleed illustration, and if several jobs are to be ganged together on the same flat, then double trims are required (see



57.621

Figure 9-17.—The window for a bleed illustration should extend one-eighth inch beyond the trim line of the layout so that one-eighth inch of the illustration will trim off the page to ensure that the page will bleed.

fig. 9-18). Here, you should allow a 1/4-inch trim margin between the jobs when one requires trim for bleeding and the other requires you to add two sets of trim (tick) marks to your flat. One tick mark indicates the first cuts on the press sheet, and the second tick mark indicates the line on which the second cuts, or final trim, will be made. As you strip in your negative for the bleeding image, position it so that the bleeding portion extends one-eighth of an inch beyond the final trim mark. If you use this procedure, the bleed will be provided without having the image run over into the adjoining job. If the bleed of your image will be at the gripper edge in a gang layout, you still must allow for the same extra trim margin of one-fourth of an inch along that gripper margin. Also, in this case, you will find that it is better if you allow for the same extra trim margin along the entire gripper edge of the flat. After you print the job on the press, take the press sheet to the bindery. There at the papercutter, your first cuts should separate all the pages from the press sheets. These pages are then collated and fastened together into signatures and the book is assembled. Now you can make the next series of cuts on the book to make it the final finished size.

Splicing Negatives Together

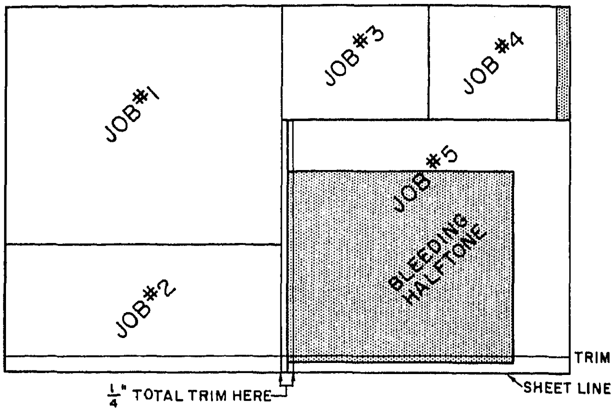
Since different photographic processes are used, you should always shoot line and halftone negatives separately to obtain the required contrast in each negative. Your work may require splicing (combining or joining) negatives together. Two line negatives may also require splicing if they have been photographed at different camera settings. A smaller negative spliced into a master (main) negative is called an insert.

As a rule, it is best to splice the smaller negative into the master negative before it is attached to the goldenrod flat. To cut the insert, you should perform the following steps:

- Tape a piece of clear glass to the top of your light-table glass to be used as a cutting base and to protect the glass surface of the light table.

- Tape the master negative, emulsion side down, to the glass cutting surface.

- Tape the required insert in its proper position over the master negative.



57.622

Figure 9-18.—Ganged jobs on a press sheet, showing the trim required to separate a bleeding job from the others.

- Cut through both the master and insert negatives with the same cut, using a razor blade or cutting knife and a metal straightedge to guide your cut. Press down firmly on the straightedge while making the cut to prevent the negatives from slipping around.

After you have finished cutting the insert into the master negative, remove it from the piece of glass that served as the cutting base. Next, position the replacement insert negative, emulsion side down, into the cutout section of the master negative. Attach the insert to the master negative with pieces of lithographer's tape. (Make sure that the tape does not cover the required image of the newly combined negative.) If any piece of the tape is covering the required image area, then that section of the tape must be removed or the tape will mask out the image under it. Spliced negatives can have images that end up so close to each other that they cannot be held together even with lithographer's tape. In this case, you can use transparent tape to hold the negative together, as long as you opaque over the tape covering any non-required transparent lines formed while splicing.

Line negatives may also be spliced together. However, splicing used to make minor changes to a page is not recommended because negatives are usually shot under different circumstances and are seldom exactly alike. Therefore, when minor changes are necessary, it is best to make them on the original copy, re-shoot it, and then use that new negative.

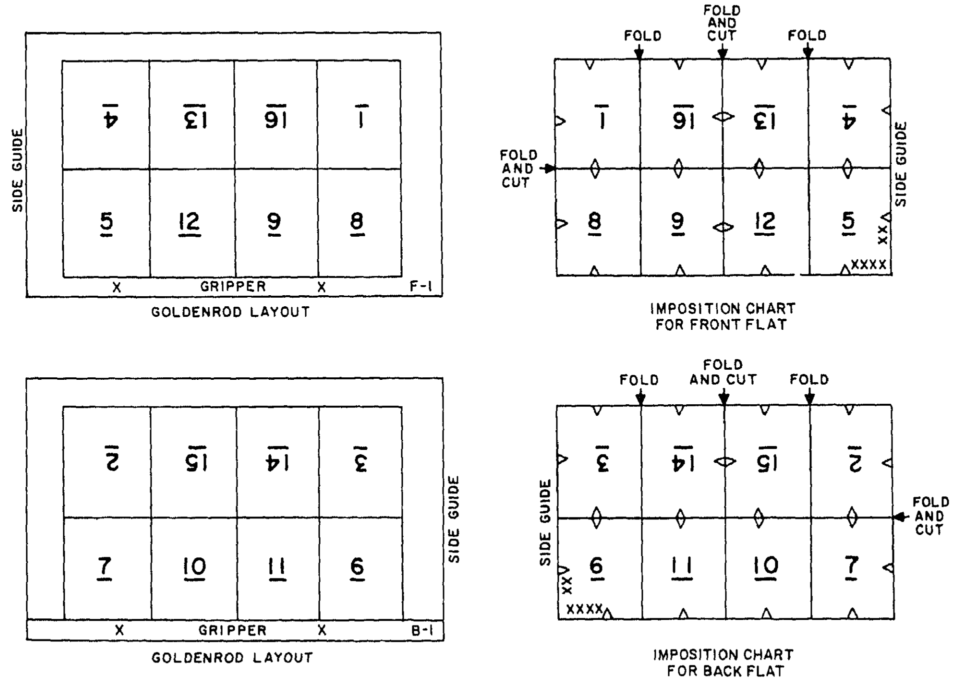
SHEETWISE IMPOSITIONS

There are several types of impositions. You should consider the capabilities of your shop equipment and then use the imposition that serves your purpose best. Many jobs call for sheetwise (backup or front-and-back) layouts; one flat will have the stripped front pages, and another flat will have the stripped back pages. See figure 9-19. Using these flats, you can then make two separate plates. Put the plate made from the first flat on the press and run the paper through. Remove the first plate and put the plate carrying the back-up pages on the press. Turn the paper stock over horizontally left to right, and run the same stock through the press again to back up the sheets. If the job is large and consists of several two-sided press sheets (signatures), you would usually run all the front sides first, then back them up in order. In very large shops, one press may be used to run the front side and another press may be used for backing the sheets up to keep the job moving faster.

Refer to figure 9-19 to see sheetwise imposition for a two-plate job. When a job consists of more than one flat, you should mark each goldenrod layout sheet so it can be identified. The first front flat should be marked F-1; the second front flat should be marked F-2, and so on. The first back flat should be marked B-1; the second back flat should be marked B-2, and so on. Also, the plates made from these flats should be marked with the same letters and numbers as the flats.

You were just told that the paper stock is turned over from left to right for sheetwise impositions. This means that the paper gripper edge of the stock is fed to the front, or head, guides on both runs through the press. However, it may be necessary for the press operator to use the side guide on the opposite side of the feedboard when making the backup run. This is because the same edge of the stock will be fed to a side guide during the second run. For this reason, strippers should identify both the gripper and the side guide edges, using *X* marks both on each imposiiton chart and on each flat.

Look back at figure 9-13 and notice that the heads of the pages are towards the vertical centerline and that the bind margin falls along the horizontal centerline. This means that the press



57.154

Figure 9-19.—Sheetwise imposition for a two-plate 16-page booklet. Arrange the pages on the goldenrod layout in the order shown at the left if you are stripping the negatives on top of the layout. Arrange the pages in the order they appear on the imposition chart if you strip the negatives under the layout sheet.

sheet will be folded on its horizontal centerline and trimmed along its vertical centerline after printing.

Notice also that if you add the folio numbers of adjoining pages (across the fold) to each other, as 8 and 1, 4 and 5, 6 and 3, and so on, these folio numbers will always equal 9 if you are working with an 8-page book. Adding folio numbers of adjoining pages for a 16-page book layout will result in a total of 17; and for a 32-page book, the folios will equal 33. This holds true here for all layouts except when you are laying out a book containing front matter. Front matter consists of pages such as a preface and table of contents, which are usually marked with lowercase roman numerals (i, ii, iii, and so on), or front matter could contain blank pages. In this case, you must add the front matter pages and the blank pages to your expected total.

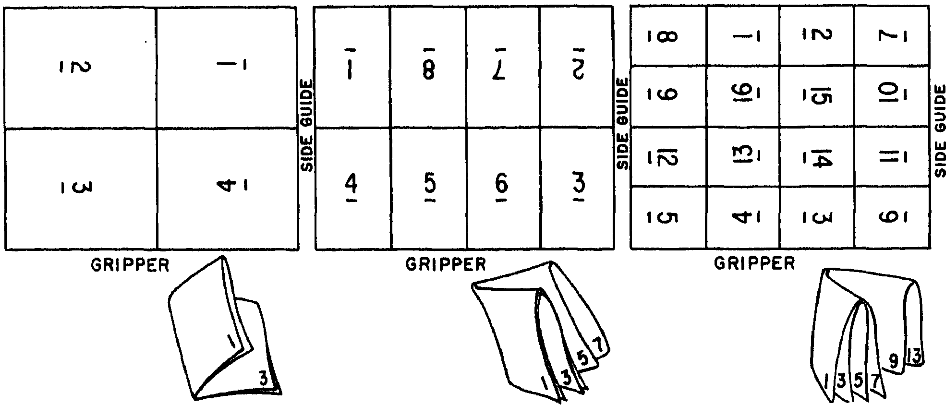
Page number 1 should always be a right-hand page, even if you have to leave a page blank. The odd-numbered pages will then be to the right of the book's binding, and the even-numbered pages will be to the left. For this reason, odd-numbered pages are often referred to as "right-hand pages."

Compare the 16-page sheetwise imposition shown in figure 9-19 with the 8-page imposition shown in figure 9-13. Notice how the pages have been rearranged so that the horizontal centerline now represents the head and cut (trim) line in the 16-page imposition (fig. 9-19). Also, you can draw in diamond shaped notches, as illustrated in figure 9-19, to indicate the lines of trim that will be done on the press sheet after printing.

WORK-AND-TURN IMPOSITIONS

As you lay out your job, you may find it is best suited for a work-and-turn imposition. This means that you can strip the negatives for both front and backup pages on the same flat (see fig. 9-20). For example, the front or right-hand pages may appear on the left side of the flat, and the backup or inside pages may appear on the right side, or vice versa.

From this work-and-turn imposition layout, the front and backup pages will be printed on the same side of the press sheet after the first press run. If your job calls for 5,000 copies, then you will run 2,500 sheets (plus a few extra sheets for set up and/or waste) through the press. Turn the press sheets over, horizontally left to right or right to left, and run the sheets through the press again. The sheets must be turned over horizontally either left to right or right to left because the same edge of the sheets (in this case, the gripper edge) must enter the press first for both press runs. Also, by turning over the sheets in this manner, you can use the same side-guide edge of the sheet if you simply switch and use the other side guide on the press for your second run. For example, use the side guide on the near side of the press for the first run and then switch to the guide on the far side for the second run. (In other words, one side guide is used to position the sheet from side to side on the press before the first side of the sheet is printed. And the other side guide is used to do the same job when the second side of the press sheet is printed.) After the 2,500 sheets are printed on both sides using the work-and-turn



57.155

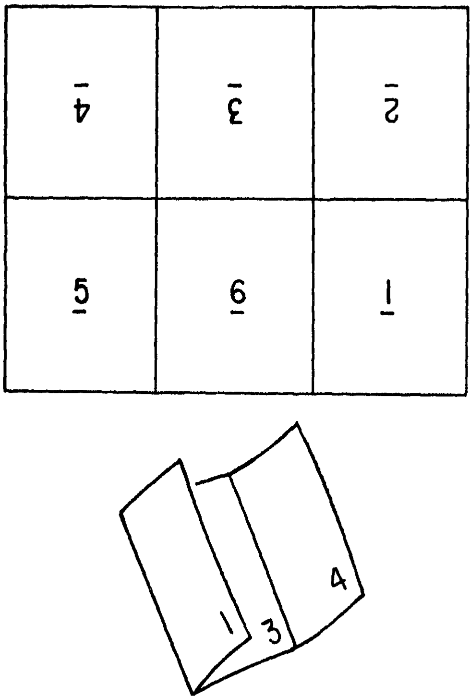
Figure 9-20.—Work-and-turn impositions. Compare the 16-page one-plate imposition shown here on the right with the 16-page two-plate imposition shown in figure 9-19.

imposition, you should cut the press sheets on the vertical centerline. Each half is a complete, backed-up unit, and you have a total of 5,000 copies.

Work-and-turn and certain other types of work require that the signatures be cut before the pages are folded and stitched and again afterwards. This means that some of the sides will be cut twice. Figure 9-20 shows how to allow for this when you are laying out the work.

WORK-AND-TUMBLE IMPOSITIONS

You could choose to strip your negatives by using the work-and-tumble (sometimes called work-and-flop) imposition, which is similar to a work-and-turn imposition. The work-and-tumble imposition differs from the work-and-turn imposition in that the negatives are stripped onto the flat so that the press sheets, after the first side is printed, can be flipped over. This is done by moving the gripper edge of the press sheets over the trailing edge before running the second side with the same plate. See figure 9-21. Work-and-tumble layouts are not used often because they do not provide as good a register as work-and-turn layouts. This loss of register is due to the gripper edge of the press sheet changing when the sheet is flopped over.



57.613

Figure 9-21.—Work-and-tumble imposition.

When you are stripping for bookwork, it is always best to use the vertical and horizontal centerlines as your reference points for all measurements. This is particularly important when you are working with a work-and-tumble job, because you will not use the same gripper edge when you flop the sheets over and make your second run. When preparing work-and-tumble layouts, you should cut in tick marks at the end of the horizontal centerline and at the trailing end of the vertical centerline. These tick marks are cut short and then placed in the trim area of the paper stock because they will print on the press sheets. You will use tick marks for reference when measuring the position of the printed image on the press sheets.

DOUBLE BURNING

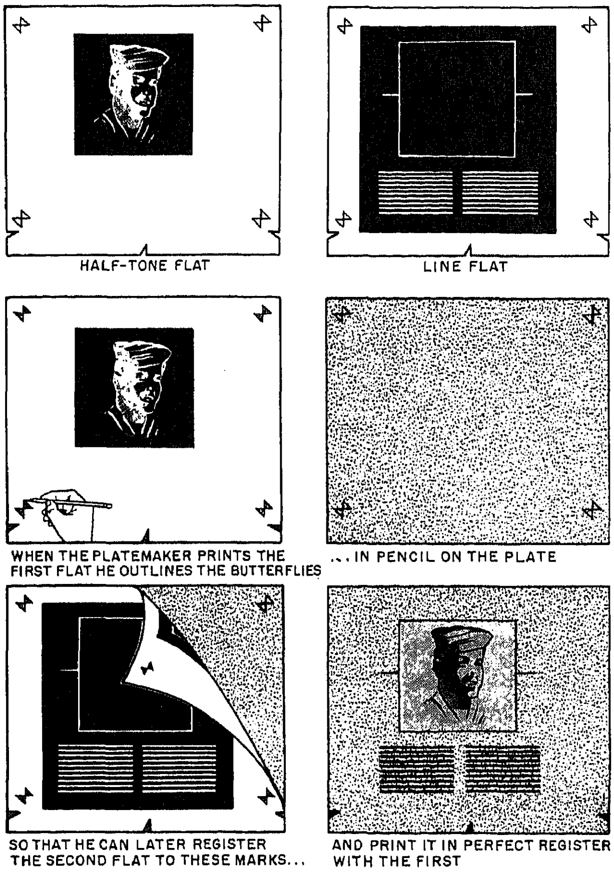
Sometimes, because of the nature of the job, you will be using two or more flats to expose the same offset plate. In platemaking, you will combine the images of these flats by exposing them one after the other on the plate in register. This process is known as double printing, or double burning.

At times, it may be necessary to print lettering or other line work over a tone area. This is known as surprinting. When stripping for a surprint, you must also prepare two flats; then, in platemaking, you will expose one flat image on the plate for the tone and then expose the other flat for the line image, using the same plate.

When preparing the flats for double burns or surprints, you should first strip your main negative on the goldenrod, then cut the required window. You can then use this flat as a master for the next flat. Next, you should tape the master flat to the light-table glass and line up the edges of another sheet of goldenrod with the edges of the master negative, then tape that sheet of goldenrod to the glass. Strip up the double burn or surprint image on the second sheet in registration with the main negative. Cut butterflies (registration marks) like those shown in figure 9-22 through both sheets of goldenrod as they are taped together. One cut is made so that the butterflies will be in the same place on both sheets of the goldenrod. Cut at least two butterflies beyond the final trim size of the job on one side or at the top and bottom of the flat.

ATTAINING REGISTER

To attain register of the images for double burns and surprinting on the offset plate, you should first align the edges of the main flat with the edges of the plate in the platemaker. Before exposing the plate, you can trace the outline of the butterflies of the main flat in pencil on the plate. Now the plate can be exposed. When the flat is changed, you can align the butterflies of the second flat with the marks you made on the plate of the butterflies of the main flat. (Instead of tracing the outline of the butterflies with a pencil, you could expose the main flat and develop just the small local area of the butterflies before exposing the second flat. Then you could use the developed butterfly images to register the second flat.)



HALF-TONE FLAT

LINE FLAT

WHEN THE PLATEMAKER PRINTS THE FIRST FLAT HE OUTLINES THE BUTTERFLIES

... IN PENCIL ON THE PLATE

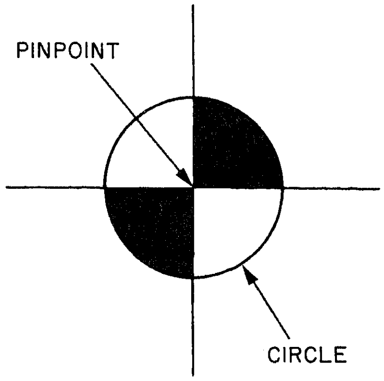
SO THAT HE CAN LATER REGISTER THE SECOND FLAT TO THESE MARKS...

AND PRINT IT IN PERFECT REGISTER WITH THE FIRST

Film Register Marks

A film register mark, like the one shown in figure 9-23, provides more accurate registration than the butterflies. The film register mark has two points of reference for registration: the pinpoint at the center of its crossmarks, and the circle. These register marks are more difficult to use, because you need a magnifying glass to align them when positioning the second flat over the plate.

Film register marks are made with the process camera as film negatives. Tape one film register mark to each of the three sides of the master negative at a location beyond the final trim size of your job. Then strip the master negative onto the first sheet of goldenrod. Cut windows to expose both the register marks and the required image of the master negative. Next, align the edges of a second goldenrod sheet to the edges of the master flat. Tape these two sheets down to the glass of the light table. You can now cut openings in the second sheet of goldenrod corresponding to the film register marks on the master flat. Position additional film register marks in these cutout areas and align them with the film register marks of the master flat. Tape the marks in place. Then register the surprint or double burn image to the master negative and tape it into position on the second sheet of goldenrod.

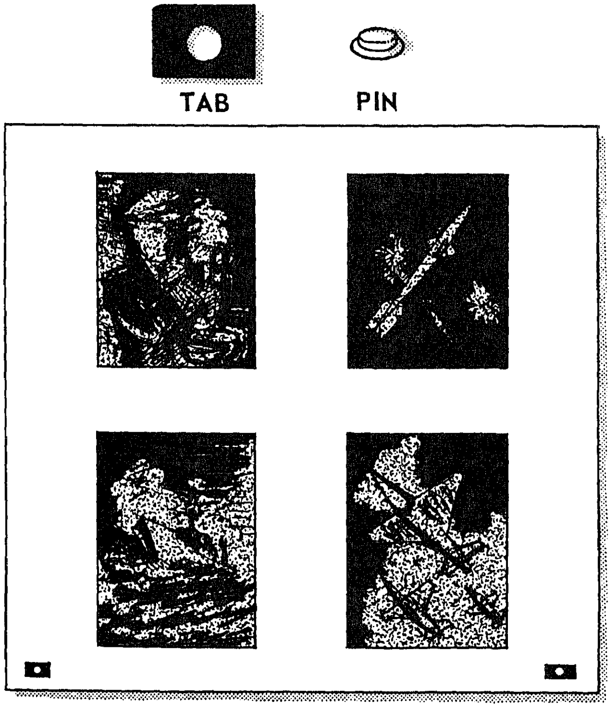


When you start making the plate with the first master flat, align the edges of the master flat with the edges of the plate in the platemaker and expose the plate. Then develop the area of the plate where the image of the film register marks were exposed. Using a magnifying glass, align the film register mark of the second flat with the image on the plate and expose the second image. The two images are now on the plate and ready to be developed.

Pin and Tab Register

Still another method to use when registering flats to each other is the pin and tab register. This method involves the use of small tabs of acetate with prepunched holes and a set of matching plastic pins, or buttons, to fit those holes. See figure 9-24.

When you prepare the master flat, after stripping in the master negative, strip two acetate tabs along one edge of the goldenrod sheet. (Strippers generally place the tabs near the gripper edge of the flat so that the tabs will not interfere with the image area, as shown in figure 9-24.) Once this has been done, insert the plastic pins through the holes in the tabs and align the edges of a second sheet of goldenrod to the edges of the master flat. You can then strip in another set of acetate tabs on this second sheet in register with the holes stripped in the master flat. Now slip the holes over the pins to prevent the second sheet from slipping as you strip in the negatives for the second flat.



57.166
Figure 9-24.—Pin and tab register method.

When you make the plate, use a similar set of pins to position the flats over the plate to make the exposures. Using the pins, align the edges of the master flat with the edges of the plate while the plastic pins are in the holes of the tabs. When the flat is in position, you should remove the flat from the pins carefully and tape the pins to the plate with masking tape.

To make the exposure of the master negative, replace the flat on the pins and expose the plate. Next, remove the master flat and mount the second flat on the same pins before exposing the plate again. When the second exposure is made, the details of the images of the two flats will surprint or double burn in register with each other.

Another slight variation of the pin-and-tab method is to punch holes in the plate as well as in the flats. These holes for the plate and goldenrod sheets are made on a punch table, and this type of table is found only in large shops. When the punch table is used, it produces holes along the gripper edge and the side edges of the plate and flats. When holes are punched in the plate and flats, the pins are generally taped down in the exposure frame bed of the platemaker, and the plate is mounted on the pins. Then you simply mount the flat for each exposure to register each image.

PRINTING ON FILM

If your darkroom is equipped with a vacuum printing frame, you may find it simpler just to expose two or more images on a sheet of film rather than to prepare additional flats. If you combine close-fitting line and halftone images on a single piece of film, you will also eliminate the possibility of out-of-contact areas when the plate is printed.

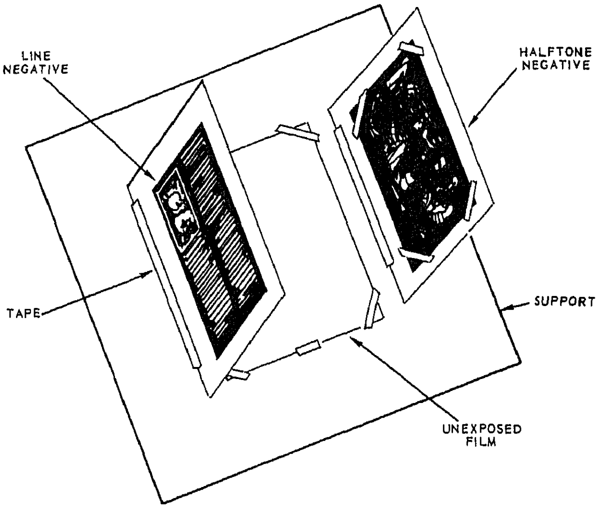
Printing negatives on film will produce film positives, and you will have to reprint these positives on another sheet of film to produce negatives unless, of course, you use duplicating film, which produces film positives from positives and negatives from negative images, as discussed earlier.

Figure 9-25 shows one method of double printing two images on film. Simply prepare one flap on your support material for your line negative and another flap for your halftone negative. Register the two images and tape the flaps (along the edge) to a thin, metal support base, such as a piece of offset plate. Then tape your unexposed film, emulsion side up, to the base. Place the assembly in the vacuum printing frame. Fold one flap back out of the way and fold the other flap over the film and close the vacuum frame. Make the first exposure. Then open the vacuum frame, fold back the first flap, move the second flap in place over the film and make your second exposure.

If the flaps are so large that you cannot fold them back in the vacuum frame, you can use the arrangement shown in figure 9-26. In this case, you hinge both flaps to the same side of the support base and hinge the film to the other side. Then, insert the film between the first and second flaps and make your first exposure. After this, remove the top flap, slip the film under the second flap and make your second exposure.

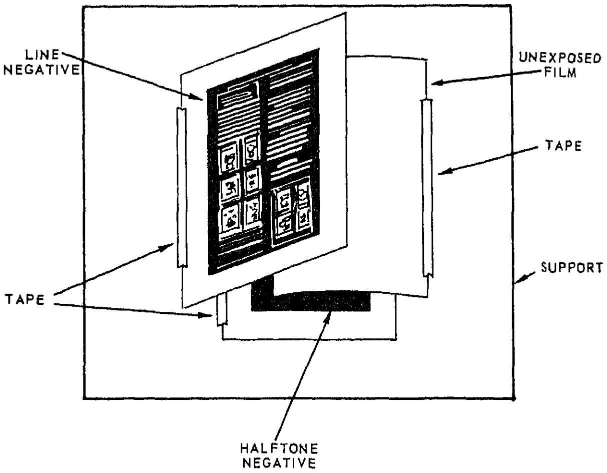
STEP-AND-REPEAT WORK

It is frequently desirable to run a job two or more up on the plate. This could mean that additional negatives with the same image must be used or that one set of negatives must be printed in two or more different positions on the plate.



57.624

Figure 9-25.—One method of combining line and halftone images on a single piece of film.



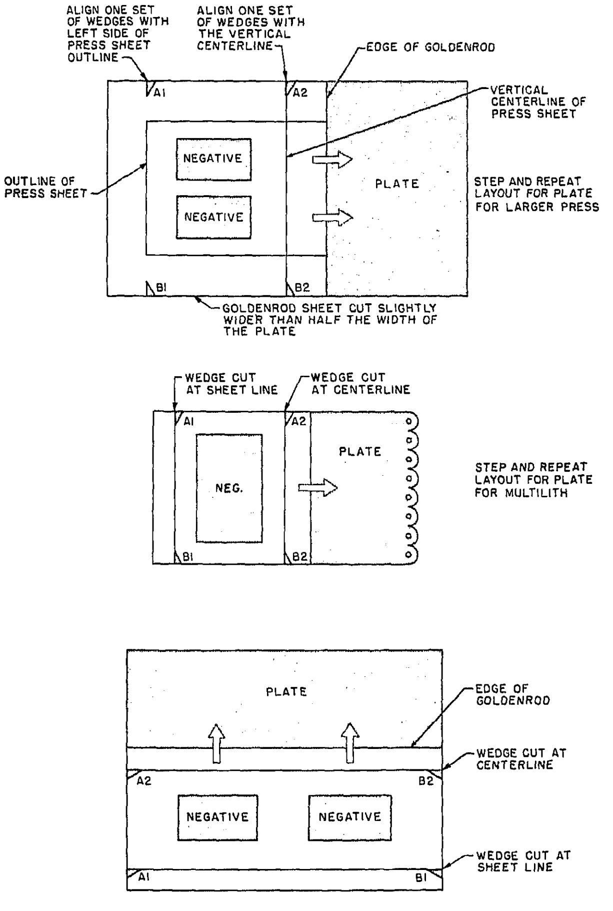
57.625

Figure 9-26.—Another method of printing line and halftone images on a single piece of film.

If the job is very simple, it may be better to make several negatives from the original copy; but if halftones, inserts, or complicated stripping operations are required, it is usually better to use the same set of negatives. This way, you will save on the amount of film required to produce the negative for your work. When you use one image and repeat it more than once, this is called step-and-repeat work.

The illustrations at the top and center of figure 9-27 show one method of repeating the job for different sizes of plates. In this case, you draw up the goldenrod in the regular manner and locate the vertical centerline and the press sheet outline. Also, draw in any additional lines needed on the left side of the layout for positioning the negatives. It is not necessary to draw the right side of the goldenrod because it will be cut off (slightly to the right of the centerline) before you use the flat to produce the plate. If it is not cut off when you are working with large flats, it might extend beyond the edge of the vacuum frame when the flat is moved for the second exposure on the plate.

After drawing up the goldenrod, you should strip up the negatives into their required positions on the left side of the flat. Then, cut in two sets of wedges—one set along the left edge of the press sheet outline and one set along the vertical centerline, as shown in figure 9-27, for registration.


ALIGN ONE SET OF WEDGES WITH LEFT SIDE OF PRESS SHEET OUTLINE
ALIGN ONE SET OF WEDGES WITH THE VERTICAL CENTERLINE
EDGE OF GOLDENROD
VERTICAL CENTERLINE OF PRESS SHEET
A1
A2
NEGATIVE
NEGATIVE
PLATE
OUTLINE OF PRESS SHEET
STEP AND REPEAT LAYOUT FOR PLATE FOR LARGER PRESS
B1
B2
GOLDENROD SHEET CUT SLIGHTLY WIDER THAN HALF THE WIDTH OF THE PLATE
WEDGE CUT AT SHEET LINE
WEDGE CUT AT CENTERLINE
A1
A2
PLATE
NEG.
STEP AND REPEAT LAYOUT FOR PLATE FOR MULTILITH
B1
B2
PLATE
EDGE OF GOLDENROD
WEDGE CUT AT CENTERLINE
A2
B2
NEGATIVE
NEGATIVE
WEDGE CUT AT SHEET LINE
A1
B1

57.167

Figure 9-27.—Step-and-repeat flats. The platemaker moves the flat from the A1-B1 position after the first exposure to the A2-B2 position for the second exposure. The uncovered portion of the plate must be masked for each exposure.

Take the flat to the platemaking section. Before the first exposure is made, you should align the flat with the gripper and left edge of the plate. Then take a sharp pencil and trace the outline of the two centerline wedges on the plate and make the first exposure. After you make the first exposure, move the flat to the right side of the plate and align the wedges cut along the outline of the press sheet with the pencil marks on the plate. These marks will enable you to position the flat properly for the second exposure. This is known as making a step-over exposure.

The illustration at the bottom of figure 9-27 shows another method of repeating the image of the job on the plate. This method is essentially the same as the one just described, except that the flat is moved from the gripper towards the trailing edge of the plate for the second exposure, and the register wedges are cut into the flat at the sheet line and at the horizontal centerline. This method of repeating the image of the flat is now known as making a step-up exposure. When you use this method, it saves production time and material because more images of the same job are printed on the one offset plate.

Instead of cutting and using the register wedges just described, you can cut butterflies into the flat, and they can be outlined on the plate. The butterflies can be aligned when the flat is moved for the other exposures in step-and-repeat work. If you use butterflies, make sure that they are cut the same distance from the trim margins of the press sheet and that the butterflies are all angled properly. See figure 9-28.

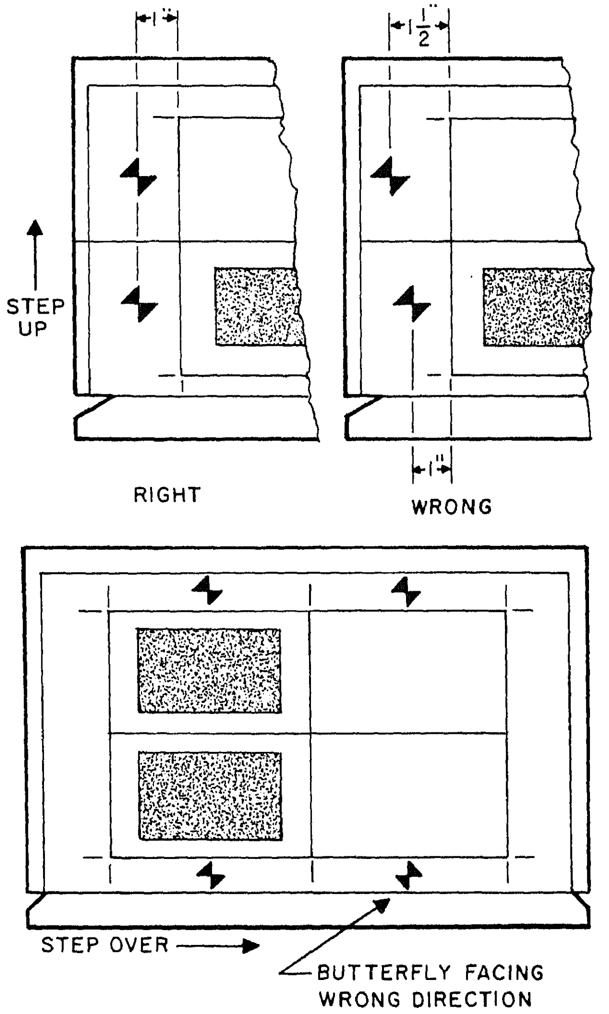


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Figure 9-28.—Be sure that the butterflies are properly aligned and facing in the right direction at each point on the flat.

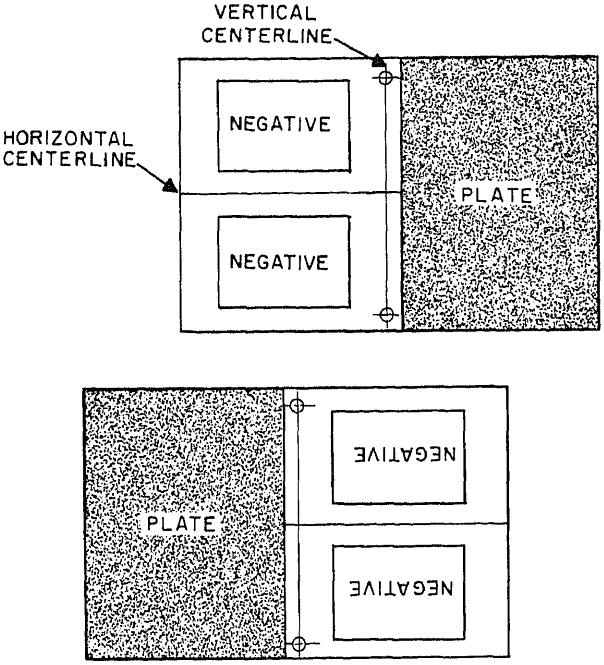

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Figure 9-29.—Note that only two sets of register marks are required. They should be placed along the vertical centerline equidistant from the horizontal centerline.

Figure 9-29 shows how to align register marks on a flat. Notice that the register marks are placed on the vertical centerline at equal distances from the horizontal centerline of the press sheet. Only one set of register marks is required for positioning the flat during the exposures. Figure 9-30 shows how to prepare a layout for repeating the image four times on the same plate.

If a surprint or double burn is involved in a step-and-repeat layout, the same registration marks as the ones used in the flat for the master negative must be cut in the flat for the surprint in order to obtain proper register when making the plate. In some cases, the surprint (or double burn) and master negatives are overprinted on film to combine the required images before you do the stripping. This, of course, simplifies your work in stripping by cutting down the number of flats that you will have to prepare.

Printing plants that specialize in chart and map work, labels, and small forms use photocomposing machines for step-and-repeat work and combination work. Do not confuse these machines with the photocomposing (typesetting) machines. The photocomposing machines used for step-and-repeat work consist of a printing frame (negative carrier) that can be moved about over a bed supporting the sensitized offset printing plate. Also, they are built to register to one thousandth of an inch (0.001″). See figure 9-31.

STRIPPING FOR COLOR

If you are stripping up a simple line color job and the colors do not overlap, you may use only one flat. Then when you make the plate for a color, mask out (cover) those areas on the negative that are not to print in that color when the plates are made for each color.

If the colors are to overlap, it will be necessary to make a set of flats, one for each color. In this case, you may use the flat for the main color as a master. Line up the main (key) flat on the light table and then strip up the flats for the other colors by using the same method that you used in stripping up flats for surprinting. Include registration marks (+) in all flats to use as guides in registering the work on the press as the colors are run. You can cut these marks into the goldenrod, or you can strip negatives that have the image of registration marks onto the goldenrod.

Layouts for color register are difficult to prepare because paper stock does not maintain accurate dimensions under certain conditions. You may use the following method in making layouts for close-register work.

Strip up a master flat containing all the printing detail and reference marks that will be required for the entire job and take it to the platemaking section. There you can use the master flat to prepare as many copies of the master image as are required on separate sheets of acetate or paper that have been coated with a blueprint solution, which develops out into a light-blue positive image. Since light can pass through these blue lines easily, you can simply tape the images in register for each color on separate sheets of goldenrod over the blueline images. Mask off the unwanted image areas with goldenrod paper.

REVERSE LETTERING

Some effects, such as reverse lettering (white lettering against a dark background), require a film positive of the lettering. This film positive is generally made on thin-base film and is stripped

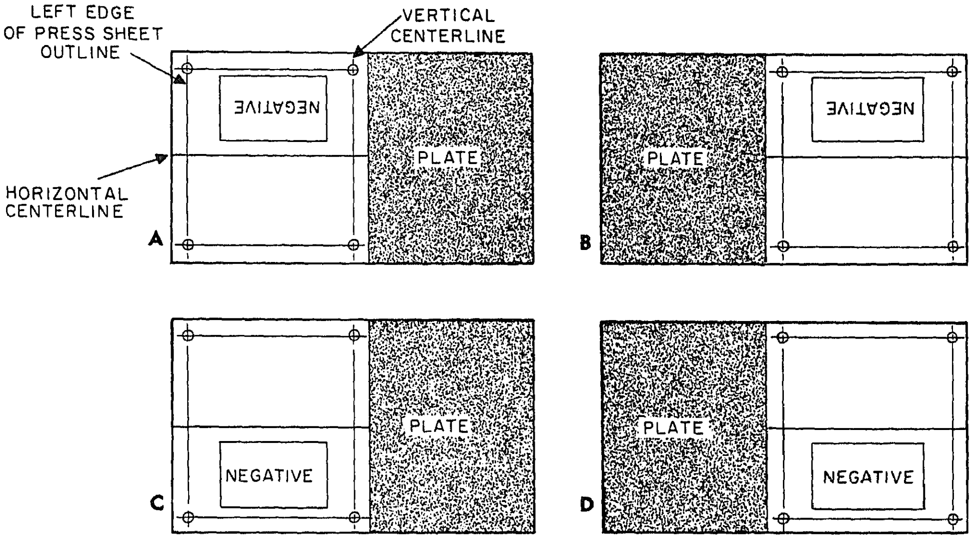

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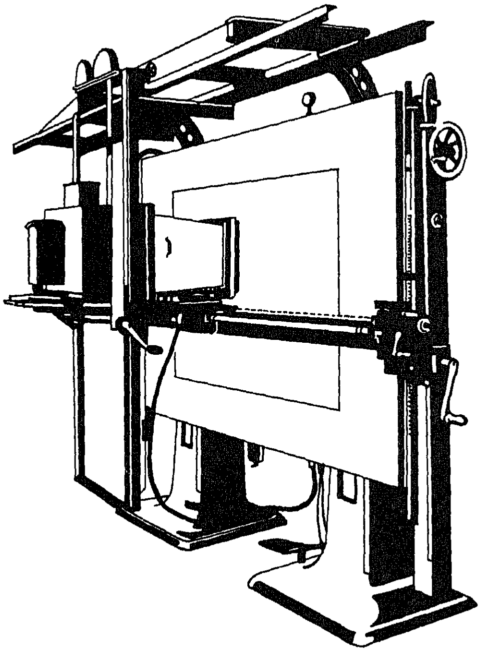
Figure 9-30.—Layout and platemaking procedure for repeating one image four times on a plate. As each exposure is made, the uncovered portions of the plate must be masked off.



57.168

Figure 9-31.—Step-and-repeat machines, similar to this, are used to produce plates for maps and charts and label work.

on the same flat as the master negative so that it overprints the master negative on the plate. When you are stripping line positives over tone areas, the negatives should be stripped so that the tone negative will be in direct contact with the plate when the exposure is made. This arrangement will keep the light from spreading, and it will produce a sharper dot formation on the plate.

The film positive must always be a piece of film as large as, or larger than, the negative it is to cover, so that it will not leave a shadow or edge in the tone area when the plate is developed.

TINT AREAS

Although you may make tint sheets by photographing a sheet of white paper through the halftone screen, shops generally use commercial tints (benday tint tones). These tints are available in tone values ranging from 10 percent to 80 percent and in screen rulings measuring from 50 lines to 175 lines.

Tints are available in standard angles of 15, 45, 75, and 90 degrees. For your stripping work, you may use a 45-degree angle in cases where only one color is involved; but if the job calls for a tint of one color to be printed over a tint of another color, you should use a different angle for each color.

If you are using only two colors, use a 45-degree angle for your strongest color and a 15- or 75-degree angle for the other one. If you are running four colors, use a 15-degree angle for blue, a 45-degree angle for black, a 75-degree angle for red, and a 90-degree angle for yellow. The degree of angle and other information are generally shown in the margin of the sheet on commercial tints.

When a tint is required, the originator of the artwork may paste a piece of black paper over the desired area of the copy, or he may fill in the area with india ink. The filled-in area will photograph as a transparent window on the negative.

In some cases, the originator may simply outline the area for the tint on the layout with india or red ink and indicate that a tint is to go in the area by marking in instructions on a tissue overlay. In such cases, it will be necessary for you, the stripper, to cut a window in the master negative, using the lines ruled in by the originator as a guide. The tint film should overlap the edges of the window by at least one-fourth of an inch. And it should be taped to the main negative in such a manner that the emulsion side of the tint will be in direct contact with the plate when the exposure is made. Flat tints can create contact problems when the plate is exposed if they are not handled properly. Several thicknesses of tape, for example, can prevent proper contact and cause a dark rim or halo around the outer edges of the tint area when the plate is developed. You are more likely to have out-of-contact areas if you cut windows in the main negative than if clear openings are provided on the negative in the tint areas.

To eliminate out-of-contact troubles, some strippers treat tints as surprints instead of stripping them into or over the main negative.

PROOFS

You can make proofs of your flats to check how they will work on the press sheets even before the plate is made on blueprint or silverprint proof papers. You can make these blueprint or silverprint proofs by exposing the proof paper through the flat in a vacuum frame for about 4 or 5 minutes—until the paper turns blue or brown, depending on your choice of proof papers. Check the information provided by the manufacturer to find the exposure time of the proof paper.

To see how an image will fit on the press sheet after printing, you can use either blueprint or silverprint proof papers. These papers are very helpful when you are proofing any individual flat. After the exposures are made, the image will appear on the proof paper just as it will on the press sheet. Now you can check or trim the margins and check the image position with the proof sheet even before the offset plate is made.

On a sheet of silverprint proof paper, you can make proofs from your color work flats by successively exposing the flats for each color, one after another in register on the proof paper. The negative on each flat is held in contact with the proof paper in the vacuum frame. Each negative can be exposed for a different length of time so you can identify the separation of colors by the differing shades of brown on the finished proof sheet.

The blueprint and silverprint papers should be kept out of strong light unless they have been fixed in the proper solutions after exposure.

To fix silverprint proofs, you should place them in hypo solution. To fix blueprint proofs, place them in a solution of potassium ferricyanide.

(When making offset plates for surprints, double burns, or step-and-repeat jobs, you could tape small pieces of proof paper to the plate so that the butterflies or other register marks will print on the proof paper. You can then register succeeding flats to the marks on the proof paper created by the master flat. The proof paper pieces attached to the plate are, of course, removed before the plate is developed. This system eliminates developing register marks on the plate and then removing them later.)

Light-sensitive, color-coated acetate sheets are available commercially and may be used to proof color jobs. These sheets are produced with coatings in different colors. They are exposed to light through the flat for a color and then are developed with a chemical that dissolves the unexposed areas of the coating, leaving a colored image on the acetate. When the sheets of each of the colors are registered one over another, a proof showing how the colors will fit on the press sheet is produced. These sheets may also be used for proofing individual black-and-white halftones.

A Diazo machine may be used for making proofs from film positives. Diazo paper is coated with a light-sensitive dye that can be decomposed or bleached by light. A mercury vapor lamp exposes the paper through the film as the two pass around a glass drum. Part of this dye is bleached out by the light, and the remaining dye is then darkened by ammonia fumes or with a special developer as the paper continues through the machine. These machines ordinarily produce positive copies from positives and negatives from negatives, although special papers that make it possible to produce positive prints from negatives, and vice versa, are available.

SUMMARY

After you have produced all the negatives and/or positives needed for your job, take them to the stripping area. There they will be placed in their proper positions on a support material and corrected if necessary. This process is referred to as stripping.

You will use a variety of stripping materials and equipment as you strip the job. Masking sheets, called goldenrod, serve as a support base to hold the negatives in place. These goldenrod sheets get their name from their color, which is usually yellow or reddish orange. They are used to mask out the larger non-image areas when the plate is exposed. Most of your work will be stripped with goldenrod paper. However, goldenrod is also available in acetate if increased stability is needed for close register work.

Preprinted goldenrod is used for stripping small or medium sized jobs because it has a preprinted grid of guidelines. You can also print your own goldenrod for your particular stripping requirements, such as those for Welcome Aboard brochures or family grams.

Goldenrod sheets that are not preprinted require that you add (draw in), using a light table, the required guidelines to show the accurate positions for your negatives.

Some light tables called line-up tables are equipped with movable straightedges. If the light table you are using is not so equipped, draw the required guidelines with a ruler or a straightedge.

Special adhesive tape is also used in stripping to aid in masking out unwanted images for the plate. This tape, called lithographer's tape, comes in red or black. Because of the color in lithographer's tape, the light passing through the negative during exposure of the plate is filtered out. Clear adhesive tape is more economical and should be used instead of lithographer's tape whenever unwanted images on the negative are not a factor. Make sure you use enough tape to hold all negatives securely in place.

Cutting tools used for stripping and correcting negatives consist of cutting knives, scissors, and razor blades.

These cutting tools are used to cut the windows over the required images of the negatives. If a cut overlaps, use lithographer's tape to repair it and to eliminate exposure of an unwanted mark.

After the windows are cut in the goldenrod, you can make corrections to the negative with a lightproof paint called opaque. The colors of opaque generally used are red and black. Red opaque is used for covering large areas, and black opaque is used for fine-detail work.

When you are cutting through goldenrod or film, the top of the light table should be protected by adding an extra piece of glass or film to the glass top.

You can crop halftones either by using opaque over the unwanted areas, by using lithographer's tape, or by using pieces of trimmed goldenrod taped into position. Of course, the opaque, tape, or spare pieces of goldenrod will mask the light and not let the image expose on the plate.

It may also become necessary to add lines to a negative to make it print. This can be done by scratching the emulsion side of the negative with an engraving tool. When you are engraving a negative, it should be taped down so it will not move. Some engravings are done freehand, while at other times you will use a straightedge. Here again, the straightedges of a line-up table can be set to move a certain distance between each engraving.

The stripping process is important because the images of the negatives must print on the press sheet in their proper positions. Therefore, the layout of negatives must be planned. The goldenrod masking sheet must be cut square and to the size of the offset plate it will cover. Ruling (drawing) of guidelines on the goldenrod must consist of space for both the plate gripper and paper gripper margins. These gripper margins differ on different presses.

There will be times when you will have to cut and splice negatives together to get a required image for your finished page. This can be done by taping the negatives down in their required positions and cutting them at the same time. When you make the same cut at the same time, the negatives will fit closely.

Use lithographer's tape where the edges of the negatives meet, so that a line will not be reproduced on the plate. Since lithographer's tape masks out any image it covers, be careful not be cover any required image.

After all of your guidelines are drawn and all of your negatives are made, you are ready to arrange the pages in their proper sequence. If you use a sheetwise imposition layout of pages for fronts and backs, the press sheets will be turned over horizontally, left to right or right to left, after changing the press plate to the plate stripped for the second side. In a work-and-turn imposition layout of pages, both the fronts and backs of the press sheets are stripped on the same flat. These press sheets are also turned over horizontally left to right or right to left before making the second press run using the same press plate. With a work-and-tumble imposition, again the fronts and backs of the press sheet are stripped on the same flat. Here the work-and-tumble (sometimes called work-and-flop) arrangement of pages requires that you turn the press sheets over from their gripper edge towards their trailing edge. In a work-and-tumble imposition, you have to change to a different gripper edge of press sheets when you turn them over for the second press run. This change can cause a loss of register of image during this second run. Therefore, the work-and-tumble imposition is not often used.

When the images from two or more flats must be combined on one offset plate, you should strip the images on flats so that they are registered with each other, and you should also register the flats and the plate together. When two or more flats are used to make the image on an offset plate, the process is referred to as double printing, or double burning. When double burning combines line work (to include lettering) with tone work, the process is referred to as surprinting. Before stripping in the negatives of additional flats for both double burning and surprinting, you should line up the edges of the second or any additional piece of goldenrod with the edges of the first flat (master). Then add the required negatives or any additional negatives to their respective flats. Be sure to keep all of the negative images and their goldenrod sheets in register with each other and the master flat.

With all of your flats stripped in register, stack the flats in register with the master flat on top and trace butterflies along the edges and beyond the final trim size on the master flat. Now cut out the butterflies with single cuts. After you align the edges of the master flat with edges of the plate, trace the butterflies with a pencil through their cutouts on the plate, or just expose the plate without doing the tracing. If the butterflies are not traced onto the plate, you must develop just the small area of the plate where the butterflies are located after exposure. In either case, the butterflies must be visible so that the butterflies on the second flat can be lined up with the butterflies on the plate. Some strippers use pieces of film with the negative image of film register marks, which are stripped into each flat in register, to register the flats to the plate. When you use film register marks on your flats for double burning or surprinting, you must develop just the small area of the plate where the mark is located, so that the mark can be used to align the additional flats.

Still another method of registering flats to each other and flats to the plate is with pins and tabs. Here acetate tabs with punched holes are stripped in register to each of the required flats. To extend the pin register to the offset plate, you need to punch holes corresponding to the ones in the flats into the plate. To get the register you need, these holes are placed on matching plastic pins as the additional flats are stripped or the plate is exposed.

If the job is small enough to fit more than once on the press sheet, then you could make extra negatives and strip them so that the images can be plated and run two or more up. It is even simpler just to strip one negative or a set of negatives in the case of printing more than one job. Then use additional register marks on the flat to reproduce an image more than once on the plate. These extra register marks are drawn on the plate and lined up between exposures as the flat is moved around the plate, repeating the same negative images.

When you are to strip flats for color printing, a separate plate image is needed for each press

Other reference lines that may be required on your goldenrod could be centerlines, trim lines and finished-page-size lines, and fold lines.

Some strippers produce complex layouts, while others use only a few guidelines. Be sure to use all the guidelines you need.

After you have drawn all the guidelines needed, attach the negative in its required position to the underside of the goldenrod. Then cut the windows to the images, and opaque the negative. Once you have completed all these operations, the goldenrod is then considered a flat.

If you are preparing a flat for a job that is narrow in width, then placement of the negative image is important. Offset presses have a device called a sheet detector or impression trip, located just ahead of the printing unit. The press sheet must trip this device as it is fed into the press. If this sheet detector is not tripped, the plate image will not transfer to the press sheet. This detector is located off center on some presses, so you must strip negatives for narrow widths of stock off center, depending on how narrow the stock is and the size and make of the press you will be using.

Preparing flats for larger presses is done basically the same as for smaller presses. However, since you now have a larger area of goldenrod on which to draw your guidelines, you may find that you can use other lines as reference points. Unless you are using the entire area on the press sheet for one image, you may be able to print many smaller pages for the same job since you have a larger press. After the pages are printed, they will be cut apart in the bindery.

Remember: Because of the extra area of the goldenrod sheet, you can now draw in guidelines for each of these pages in greater detail.

After all of the guidelines are drawn on the goldenrod, the negatives are tacked to the underside of the goldenrod with tape. Some lithographers cut small holes in the top of the goldenrod where the negative will be positioned. If you decide to do this, simply move the goldenrod over the negative until it is in the required position. Holding the goldenrod and negative in position, put pieces of tape over the holes, goldenrod, and negative to tack them together. After all of the negatives are positioned, the goldenrod sheet should be turned over and more tape added to securely fasten all negatives in position.

Of course, all images on a flat do not have to be for the same job. When you strip together images of more than one job on the same flat, you have what is called a gang layout. However, before doing a gang layout, you should consider the following factors: You must be able to use the same kind of ink and paper for all of the jobs in the gang layout; the length of the press run must be the same; and the jobs must be laid out so that each one can be cut from the press sheet economically.

To strip a job for a large book that will have several folded sheets and will contain several pages, you should prepare an imposition chart. This chart is simply a blank press sheet that is folded down to the approximate finished page size with page numbers (folios) to show the required page sequence. When the imposition chart is unfolded, it can be used as a guide to draw your goldenrod layouts.

The multipage layout jobs will normally require the second side of the press sheet to be backed up on the press with other pages for the final book. To print the second side of press sheets, you must turn them over. The direction in which the press sheets should be turned over will be determined by the arrangement of the negatives on the flat for the second run in relation to how they are arranged for the first run. Since the page arrangements are determined from the imposition chart, they are called impositions. If you are doing a bookwork imposition layout and all of the pages are the same size, you should make a master layout guide on translucent acetate. Your master layout can then be placed under each flat of the job. By copying the master layout on each sheet of goldenrod, you can quickly finish your needed guidelines.

As you strip the goldenrod sheets, place the fold and trim marks in the flat. When you cut the marks through the flat, they will print on the plate and press sheet outside the finished page margin. These marks will be used for registration throughout the job—on the press as well as in the bindery. When a stripping job calls for an image to run off the edge or edges of the final page size, this image is known as a bleeding image. Bleeding images require that you allow for an extra trim area on the press sheet when drawing the flat, so that an extra trim of that page can be made.

color run. Individual flats could be made for each of those plates. However, if the different colors of the total image do not overlap, you can, perhaps, strip up one negative and then mask out the unnecessary color areas as you make the plates.

When you are stripping a number of flats for different colors to be printed on the same press sheet, the flats must all be stripped to register with each other. This is done so that the plates created will have the images for the color in the required position in relation to the other colors of the job.

To strip a flat for reverse lettering on a tone area, you will have two negatives. These two negatives can be stripped to the same goldenrod sheet. First strip in the tone negative. Then attach the thin-base film positive with the lettering required over the tone area in register and tape it down.

You can also add tints to the offset plate by preparing the flat with its required negative and then adding a benday tint sheet to the negative or flat before the plate is produced. To avoid poor contact between the negative and the plate, you must take care when you are attaching tint sheets to the negatives.

When you produce the flats for a unique plating operation, it is a good idea to check your stripping work by making proofs of your flats. These proofs can be made on either blueprint or silverprint proof papers. As the proof is created, you simply treat the sheet of proof paper just as you would the offset plate you were exposing. Then examine it to see how your plate will look.

Certain small pieces of proof papers can also be attached to an offset plate in the area where register marks will appear. When exposed in platemaking, these register marks will appear right away on the proof paper, and then their image can be used to register other flats. This process will preclude developing the register marks on the plate surface itself.

Diazo proof papers can also be used to proof your flats. However, these papers require a Diazo machine to process them. The Diazo machine uses a mercury vapor lamp to expose the proof paper and partially develop it. The paper passes through the machine a second time to complete its processing.

Platemaking will be presented in the next chapter.

CHAPTER 10

PLATEMAKING

The Navy Lithographer uses the flats prepared in stripping to produce the offset lithographic (press) plates in the platemaking process. Many lithographers feel that the offset plate is the heart of the lithographic process because the plate is put on the press later to run off the press sheets. Without the plates required for the image, the offset press cannot do its job.

The lithographic offset plates will function based on the principle of lithography that grease (ink) and water will not mix. The image areas of a plate accept ink but reject water. The non-image areas of the plate react the opposite: they accept water but reject ink. The greater the difference between the ink and water receptivity of the two areas, the better the plate will perform on the press.

Limestone slabs were originally used as a base for lithographic images. As rotary presses replaced the slow, cumbersome, stone flatbed presses, limestone gave way to metal plates (monel, stainless steel, zinc, chromium, copper, or aluminum). The use of rotary presses meant faster output, better impressions, and improved working conditions for press operators. The rotary presses led the way into offset printing and the metal plates remained the carrier of the inked image.

Offset presses were continually improved, but for years metal plates created problems. Platemaking was a process of trial and error. Platemakers adopted and discarded many steps and processes in search of a reliable offset plate.

Metal plates were not porous, as were the limestone slabs, and it was necessary to grind them with abrasives to produce a roughened (grained) surface that would hold water and ink. One method of graining the metal plate or regraining the more durable plates for reuse was accomplished by the use of a graining machine shown in figure 10-1. The plate was fastened to the bed and covered with steel, glass, or wooden marbles. Water and an abrasive, such as carborundum, aluminum oxide, or quartz, was added. When the machine was turned on, the bed vibrated in an eccentric motion, causing the marbles to roll, crush the abrasive, and pit (roughen) the surface of the plate. Other processes of graining evolved and include brush graining, dry sandblasting, and wet sandblasting.

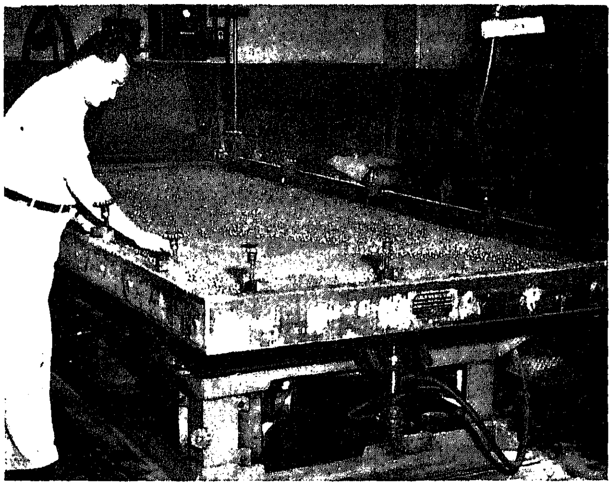


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Figure 10-1.—Graining machine. Metal plates were grained in equipment similar to this before the introduction of presensitized plates.

It wasn't until the mid-1950s, when the first presensitized aluminum plates were introduced, that the lithographic trade obtained a plate that was easily processed and that produced a constant high-quality image. The costs associated with platemaking were also lowered by the use of these plates. What formerly was a highly specialized operation became within reach of each lithographic shop.

Today, presensitized aluminum offset plates are most often used as a standard in the lithographic industry. As you become familiar with the various types of plates, you will see that there isn't any type of plate that fills every printing requirement. You'll find some plates are too expensive for certain types of work, others may not be capable of reproducing the quality needed, and still others may not have sufficient press life to complete an extended press run.

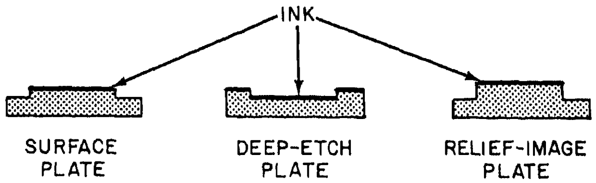
In this chapter, the characteristics of plates and platemaking processes in use in the Navy are presented. This information will help you to select the correct plate for the printing requirements in your day-to-day work. Also, this chapter will present the steps required to produce the required image on the plate you will need to run your press sheets.

MAIN TYPES OF PLATES

Basically, all plates fall into one of three categories: surface plates which have a flat image formed on the surface of the plate, deep-etch plates which have an image etched slightly beneath the surface of the plate, and relief-image plates which have the background etched out slightly so that the image stands above the surface of the plate. (See fig. 10-2.)

PRESENSITIZED PLATES

Presensitized plates are generally made of plastic, paper, or aluminum and have little or no grain. They are coated with a light-sensitive coating by the manufacturer and come to the platemaker ready for use. The diazo coatings used on presensitized plates are greatly affected by infrared rays, but yellow light has little or no effect on them. For this reason, yellow safelights are generally used in the platemaking area to avoid toning (unwanted exposure). Since diazo compounds are adversely affected by contact with metal, aluminum plates are treated (covered with a barrier coating) before the diazo coating is applied. Zinc cannot be successfully treated and, therefore, is not used as a base for these plates. Presensitized plates are sometimes coated on both sides so that each side of the plate can be used for printing. These plates are also coated with a diazo compound which is an aromatic nitrogen by-product of coal tar that is sensitive to light. Presensitized plates are available for use with both negatives and positives.



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If you are working with negatives, the plate is exposed and then developed with a solution which dissolves the coating in the nonprinting areas. After this, the image areas are covered with a special lacquer emulsion and the plate is gummed. A slightly different procedure must be followed in processing positive-working plates. A film positive is used in exposing the plate, and the plate is developed in a special-developing solution. In this case, however, the image is still sensitive to light, so it must be *fixed* if the plate is not to be put on the press immediately. After development, the plate is washed in running water and is then fixed with a solution which stops all action of the developer. The image is then lacquered with a lacquer emulsion and the plate is gummed and dried. Lacquer is a vinyl resin that strengthens the image and makes it resistant to the action of solvents, acids, and gums. A lacquer emulsion is used on presensitized plates. It contains a lacquer resin and a desensitizing gum which is deposited on the nonprinting areas of the plate.

There is another type of presensitized plate that is very popular in commercial shops when long runs are involved. Instead of the diazo coating, it uses a light-sensitive photopolymer coating made of plastic or lacquer. Plates made with this type of coating are good for 100,000 impressions or more. These plates use a different chemistry and a different processing procedure than the diazo-coated plates previously mentioned. When photopolymer plates are exposed to ultraviolet light, the light causes the image area to become insoluble and ink receptive without lacquering or further processing.

Plates coated with the special diazo solution are processed and run on the press in the same manner as other presensitized plates. Presensitized plates have a definite shelf life. After the plate is run on the press, the plate can be saved if the image is to be run again, saving you the task of making another plate later.

DIRECT-IMAGE PLATES

Direct-image plates, or masters, originally consisted of plastic-coated paper or an aluminum sensitive, and the image was put on them by direct means, such as typing, drawing, ruling, and so on. You can produce an image on these plates by running them through copying machines.

Instructions for preparing direct-image masters are found in chapter 3 of this manual.

Although these masters vary slightly, paper product coatings, such as Electrofax, are included in the paper plate category. Electrofax plates have a coating of zinc oxide which can be exposed and developed with a toning powder.

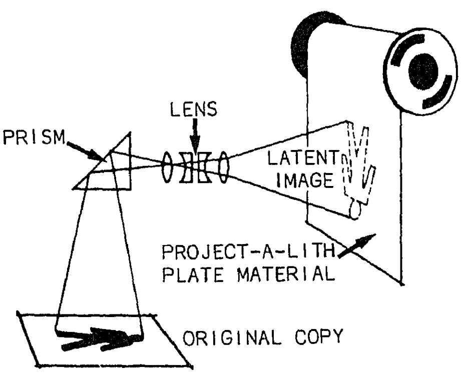
CAMERA-DIRECT PLATES

Camera-direct offset plates (platemasters) can be produced in your shop if it is equipped with the required photolithographic camera equipment. Camera-direct (projection) plates are produced with the aid of a projector similar to a photographic enlarger or a camera. This machine includes a camera and also a plate processor, combined into a single unit.

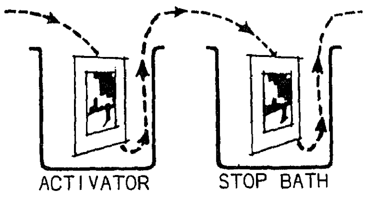
When you place the original copy in the platemaking camera, the image is projected onto the photosensitized plate. Because these plates are produced directly from the original copy to the plate with the aid of the camera, no film is used. This, of course, eliminates the stripping and conventional direct contact (between plate and flat) in platemaking. Regular line copy and previously screened halftone clippings can be photographed with good results, provided the halftone screen used for the clippings was not finer than 100 lines per inch.

When using the camera to produce camera-direct platemasters, you must first load the copyboard. Then set the lens aperture opening and adjust the copyboard for the proper ratio of enlargement or reduction. You must also make a few preliminary settings, such as setting the timer to control the length of the exposure and setting a dial to control the cutting mechanism. The plate material on the roll will be cut off to the desired plate length after the exposure is made. Once these settings are made, you simply press the exposure button and from that point on, all operations are entirely automatic.

The exposure is made on the plate itself, and a positive image is produced from positive copy. The plate consists of a three-layer emulsion applied to a polyethylene-coated paper base. It has a sensitivity similar to that of ortho film. (See fig. 10-3.) The top layer of the emulsion is a prefogged layer which holds moisture after development and which has an affinity for ink. The second layer



A prism is used to reverse the image so that it will read correctly on the plate. Plate material is wound down from roll and cut as each plate is made.



After the exposure, plate material automatically passes through processing solutions.

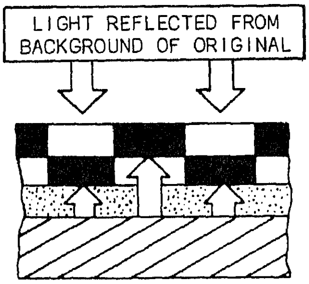


Plate is coated with a three layer emulsion. During processing, middle layer is hardened wherever it was struck by light during the exposure. Developer from bottom layer travels through unhardened areas of the middle layer to make top layer ink-receptive in image areas. Hardened areas in middle layer prevent developer from passing through and prevent top layer from becoming ink-receptive in nonprinting areas.

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Figure 10-3.—How platemasters are produced in the camera. Prefogged top layer of the plate emulsion gives plate an overall grayish appearance.

contains silver halides suspended in gelatin. The bottom layer contains a built-in developer which passes to the top layer during development to bring out the latent ink affinity in the image area.

During the exposure, the light reflected from the bright areas of the copy produces a latent negative image in the middle layer. After the exposure, the plate passes into an activator solution which develops and hardens the light-affected areas in the middle layer.

These hardened areas then form a barrier which prevents the passage of the developer from the area below to the area directly above them. And since the developer cannot pass through these hardened areas, the top layer above these areas retains its original moisture-holding characteristics.

The unhardened portions of the middle layer permit passage of the developer from the bottom to the top layer, bringing out the latent ink affinity of these (image) areas.

Finally, the plate is fixed by immersion in the second processing tank. The fixing solution also provides surface moistening of the correct pH for immediate running on the press without etching.

The plate material comes in a roll which is loaded into a magazine at the back of the camera. The material is automatically wound down and cut to plate length when the exposure is made.

After the plate has been exposed and cut, rubber rollers wind it down until it is caught by a series of conveyors which carry it through the processing solutions and finally eject it through a slot at the back of the machine.

Plates can be delivered either wet (for immediate use on the press) or dry. Dried plates must be moistened before they are put on the press, of course. These plates require somewhat critical press adjustments and cannot be used with some fountain solutions and inks. In some shops a press may be set aside and used only for running this type of plate. This eliminates the necessity of changing the press setup that would be involved in switching from one type of plate to another.

ELECTROSTATIC PLATES

The two electrostatic masters used in the platemaking processes are Electrofax and Xerography. With the Electrofax process, the plate surface consists of zinc oxide (a photoconductor) manufactured in a resin binder. This resin, containing the zinc oxide, is coated on the plate surface of the paper on a lithographic metal. First, the zinc will receive a negative charge from a corona ion source. Then, during exposure, the zinc oxide will lose part of this charge in the non-image areas when it is exposed to light.

Electrostatic masters are exposed and processed in the camera and processor combined. Cut plates or rolls of plate material are used in these machines.

Before starting the platemaking cycle, the platemaker positions the copy on the copyboard (or face down against a sheet of glass). If necessary, the copyboard and lensboard are set in positions for the proper amount of enlargement or reduction. (Some camera-processors can only produce the same size images.) On some machines a time must then be set to control the length of the exposure. Once these steps have been completed, the remainder of the process is entirely automatic.

When the platemaker closes the cover over the copy and depresses the switch to start the platemaking cycle, the cut plate or roll of plate material is fed into the machine. (If a roll is used, it is automatically cut after the proper length has been fed through.) The plate material then passes a series of electrical discharge wires, called a corona unit. (See fig. 10-4.) The corona wires glow from a charge of high-voltage electricity, causing the air around them to be ionized. The plate is bombarded by electrons as it passes under these wires. The zinc oxide coating on the plate picks up a negative charge of static electricity.

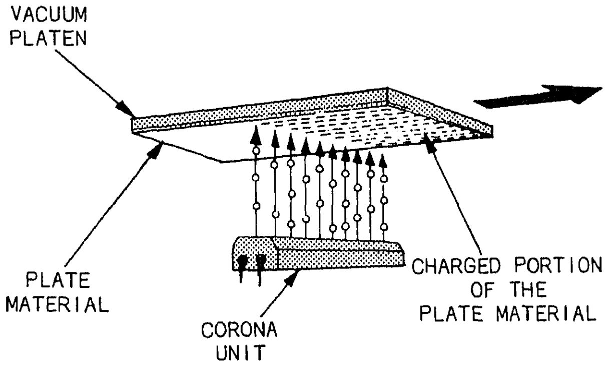

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Figure 10-4.—When the platemaking cycle begins, the vacuum platen picks up the plate material from the magazine and carries it over a set of corona discharge wires.

The charged plate is then moved into exposure position in the machine. The exposure is made automatically; the length of time is controlled by the timer which the operator has previously set. During the exposure, the plate loses its electrical charge wherever it is struck by light (in the nonprinting areas) but remains charged in the image area. The plate now carries a kind of electrical image. (See fig. 10-5.)

After the exposure, the plate is carried through a toning unit, as shown in figure 10-6, where the negative-charged image is dusted with a black toning powder or covered with a black liquid toner. The toner consists of a carrier powder or liquid and carbon particles which have been given a chemical positive charge. The toner is attracted to the unexposed (image) area of the plate because they still have their negative charge, but it does not stick to the nonprinting areas which have lost their electrical charge.

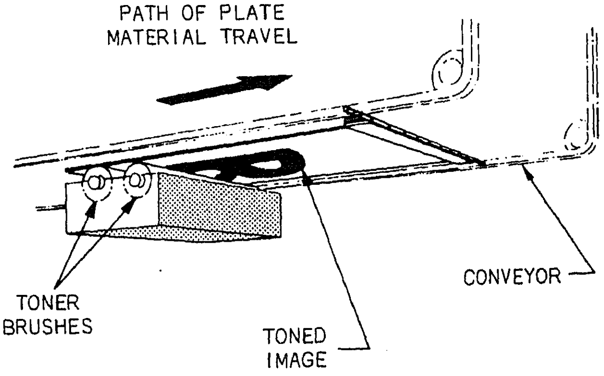

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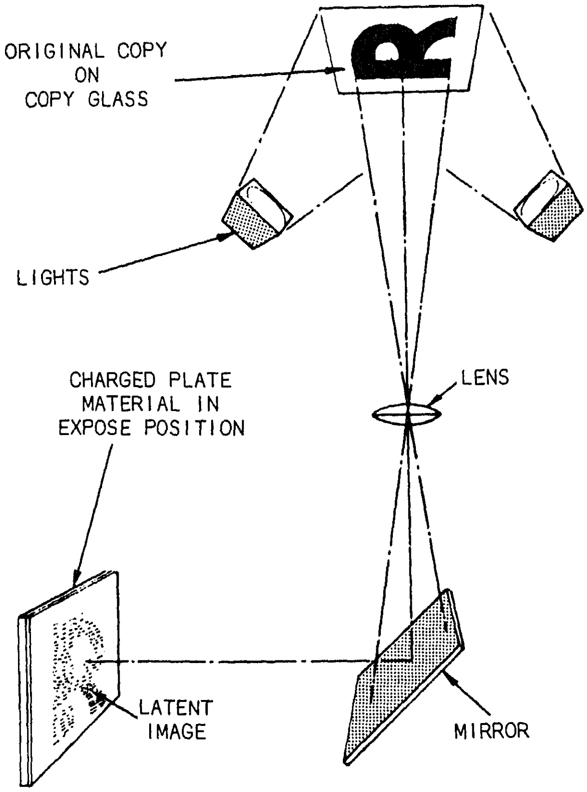
Figure 10-6.—Toning unit.

When the processing machine uses powdered toner, the plate is passed into a fuzer (heating unit) where the powder is fuzed to form a permanent image on the plate. (See fig. 10-7.) (On some machines, the plate emerges from the machine and stops at a viewing station after it leaves the toning unit. The operator can then remove any unwanted image by removing the toner from that image on the plate with a piece of cotton. The operator then returns the plate to the machine on the conveyor and pushes a button to move the plate into the fuzer.)

When you are using a liquid toner instead of the powdered toner, the plate passes through a set of squeegee rollers into a drying unit and is then ejected from the machine. It is possible to get 100 or 1,000 copies on the press when you use paper plates produced by the electrostatic process. They can be used for line and coarse (85-100 line) halftones.

Other copying machines operate on the same principle as that just described, except that they do not use the zinc oxide-coated paper. Instead



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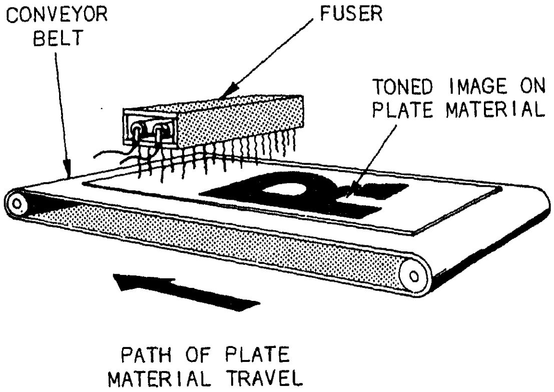

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they form their image and transfer it to ordinary paper where it is fuzed. These machines are capable of feeding and producing offset masters.

TRANSFER PLATES

Plates can be made by the diffusion transfer process in a matter of 2 or 3 minutes.

The main difference between this platemaking process and the others is that the plate material used is not coated with a light-sensitive coating. Ungrained aluminum or plastic plates are generally used.

A special negative paper is required. However, the plate is exposed much the same as conventional film and can be used in any camera, contact printer, or enlarger. Exposure is determined by test strips. Once it has been determined, the exposure will remain fairly constant if the camera setup is not changed.

After exposure, the negative and the plate are fed into a machine where they pass through a developing solution and are then pressed together by rollers. (See fig. 10-8.) The developer changes the exposed silver salts to black metallic silver in a matter of seconds. It also loosens the clear, unexposed silver salts. These salts transfer by diffusion to the plate where they blacken or form the image as development continues.

After the plate comes out of the machine, the negative is peeled from the surface of the plate. Now, the plate carries a positive image which must be fixed by swabbing with a chemical solution. The image is then rubbed up with lacquer, and the plate is dried and held for the press. These plates are good for reasonably long runs and are not as susceptible to oxidation as other metal plates. Since these plates are ungrained, they can capture very fine printing detail and will produce halftones made with a 300-line screen.

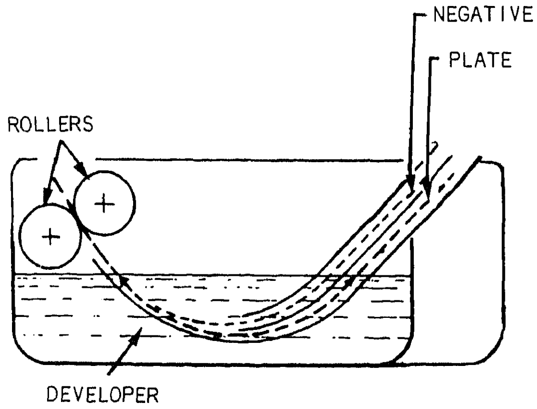

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Figure 10-8.—Diffusion transfer plate developing unit.

DRIOGRAPHY PLATES

Driography (dry) plates are a flat-surfaced presensitized plate. This flat surface has a ink-repeat coating and does not require water to keep the non-image area free from ink when the job is run on the press. These plates are referred to as dry plates.

Processing Dry Plates

Each plate is covered with a clear plastic slip sheet. You should remove this sheet before exposing the plate and save it for covering the plate after development. An ultraviolet light source is used to expose the plate; however, you must handle the plates under yellow or very subdued white lights until development is complete to prevent exposure in the nonworking area. The plate is exposed through a negative in the conventional manner. After this, it is developed in a single step with dry plate developer, rinsed with water, and then dried. It can be developed by hand or in an automatic plate processing machine.

You should place a 21-step gray scale along the gripper or tail edge of the plate to ensure proper exposure. Exposure time will produce an open step five on the gray scale. Proper exposure makes for ease in development but has no bearing on the life of the plate.

Developing Dry Plates by Hand

After the exposure, you should place the plate on a flat, smooth, cool surface. Maximum development latitude is obtained with the sink and chemical temperatures between 70 °F and 80 °F.

You will see a visible image on the plate after it is exposed. During development the coating in this image area will be removed, and the coating in the non-image areas will remain on the plate. It is the background coating that allows the plate to be run without dampeners, so you must be careful not to scratch this surface. To develop, shake the developer well and then moisten a clean developing pad. Pour a liberal amount of developer in the center of the plate and distribute it gently over the entire plate surface. You will notice a change in color in the image area after 15 to 30 seconds of gentle wiping. At this point you should increase the pressure on the pad using a circular motion to remove the coating from the image area and attain complete development. Use the flat surface of the developing pad, not the edge, to minimize the possibility of scratching the background.

After the image areas are clean, flush the surface of the plate with cool water to remove all traces of the developer solution. Do not allow the developer to dry on the plate. Lift the plate and rinse all developer from the backside and the sink surface. Blot the plate dry with a soft, disposable wipe. Do not use a squeegee as this may damage the coating in the non-image area. If the plate is not rinsed properly, it will tone on the initial roll-up when it is put on the press and will require several waste impressions to work clean.

Cover the developed plate with the plastic slip sheeting supplied with the plates to prevent scratching the background. You can inspect the plate with the plastic sheet in place. You should also keep the slip sheeting over the plate if it is necessary to cut it to size, bend it on a jig, and so forth.

Running Dry Plates

Before mounting the plate on the press plate cylinder, be sure the dampeners are disengaged. The plate will scum if it is run with water. While you are mounting the plate on the press, keep the plastic sheet in place until the plate is properly positioned. Do not wipe the plate with fountain solution or water. Add the driographic ink to the ink fountain and let it distribute over the rollers. (The inks used for dry plates have a different formulation from the offset inks commonly used, although many of the driographic inks can also be used for wet offset printing.) Once the ink is distributed, drop the ink-form rollers and allow the plate to ink up. You are then ready to start feeding the paper through the press.

If you shut down the press during the run, raise the ink-form rollers and print several more extra impressions to remove the excess ink from the image. You should also run the press to remove the ink from the image after the job is completed. Once the ink is removed, you can place the clear slip sheet over the plate and store it for future use if reruns are required. There is no need to gum the plate at any time.

PROCESSING PRESENSITIZED PLATES

Presensitized plates are coated by the manufacturer and come to you ready for use. These plates are thin in contrast to some plates, ranging from 0.005 to 0.012 of an inch in thickness. For this reason, you must handle them carefully to avoid damaging their surface and to prevent them from buckling.

Presensitized plates are produced both as negative and positive-working plates and are used with either negative or positive images. The exposure of these images and the plate processing do differ. As a platemaker in your Navy shop, you will be working primarily with processing plates with negative images and producing a positive image on the plate.

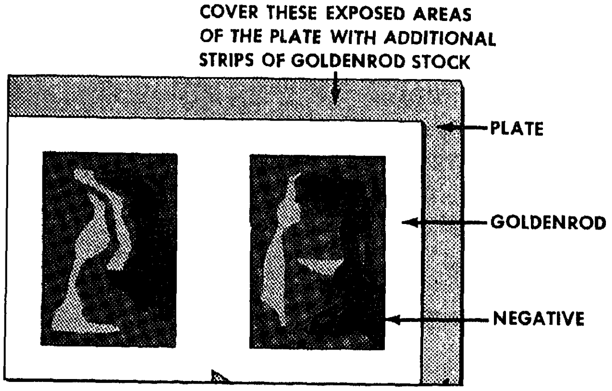
Since the coating used on presensitized plates is more sensitive to light than the coating used on some other plates, you should keep them away from strong light. When possible, they should be handled under yellow light. If yellow bulbs are not available, you may cover the regular bulbs with goldenrod paper. After you open a package of plates, be sure that they are carefully rewrapped to prevent accidental exposure on the shelf. When these plates are stored properly in a cool place, they will keep from 6 to 12 months. The expiration date is generally marked on the package; therefore, you should use the plates on a first in, first out basis so that the oldest plates will be used first.

EXPOSING THE PLATE

When you are ready to expose or print the plate, place it face up in a vacuum frame and position the goldenrod flat over it. The emulsion side of the negatives should be in direct contact with the light-sensitive side of the plate. Register the flat on the plate by accurately aligning the gripper edge of the flat to the plate and by using other reference marks provided on the flat by the stripper for positioning purposes. If any areas of the plate are not covered by the goldenrod paper, cover them with strips of goldenrod, as shown in figure 10-9.

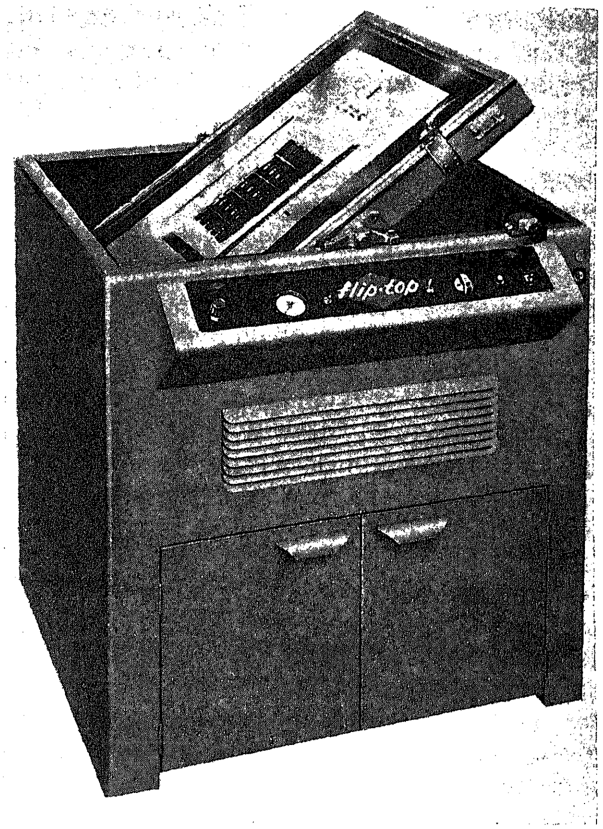
Plate exposure units similar to the one shown in figure 10-10 are commonly called platemakers. They have a built-in light source which is located inside the cabinet beneath the vacuum frame. As you can see, the vacuum frame pivots to face the light source when you are exposing the plate.

In case of doubt, it is better to overexpose a plate slightly than to underexpose it. Because if you underexpose it, no image will form on the plate or the image will be so weak that it will not stand up on the press. Whereas, if you overexpose the plate, fine lines or tone areas might fill in.


COVER THESE EXPOSED AREAS OF THE PLATE WITH ADDITIONAL STRIPS OF GOLDENROD STOCK
PLATE
GOLDENROD
NEGATIVE

57.180

Figure 10-9.—The edge of the goldenrod layout is registered (aligned) with the edge of the plate along the gripper edge and on the left side. The wedge-shaped cuts identify the gripper edge of the layout and aid the platemaker in positioning the work. The goldenrod flat generally covers the entire plate. If it doesn't, use additional strips of goldenrod to cover the exposed areas of the plate, as shown here.



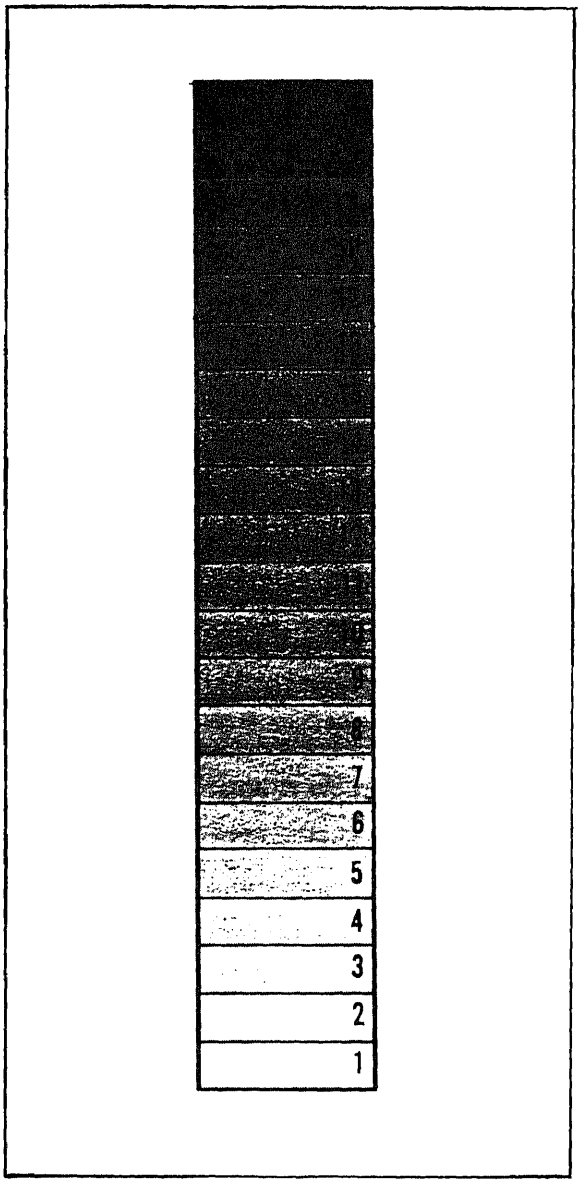
57.737X

Figure 10-10.—Plate exposure unit. This unit is a self-contained flip-top platemaker which contains a vacuum system, vacuum frame, and exposure source.

You may use a sensitivity guide (gray scale), like that shown in figure 10-11, stripped into the flat along the gripper edge so that its image will appear on the plate but not on the paper when the job is run. You can then use this image later as a guide in plate development. The gray scale is a strip of continuous tone film with 21 graduations or density steps. These steps are numbered, as you can see in the illustration, and each step is sightly more dense than the step before it. When the plate is exposed, the coating will be underexposed at one end of the scale and overexposed at the other. When you develop the plate, you will generally find that the first four to six steps will be solid, the next three or four steps will show as gray areas, and the remainder of the steps will not develop at all.

If step four is the highest completely solid step, the plate is just slightly underexposed; if step five is the highest step, the exposure is just about right. If more than seven steps go solid, the chances are that the plate is overexposed. If your press run is short or if you are working with halftones, you may find it better to expose for a solid four; but for other kinds of work, you should expose for steps five or six. In extreme cases, you may expose them for a solid seven when your image consists of line work and a long press run is required.

If the plate is underexposed, you can increase your gray scale reading by one step by increasing the exposure time 50 percent; you can increase it two steps by doubling the exposure; and



57.183B

Figure 10-11.—An artist's conception of a 21-step sensitivity guide (gray scale) used to determine correct plate exposure. Variations of platemaking sensitivity guides are available from manufacturers of plates and platemaking equipment and supplies.

increase it three steps by tripling the original exposure. Conversely, if the plate is overexposed, you can reduce your gray scale reading by three steps by dividing your original exposure time by 3; you can reduce the reading two steps by dividing the exposure by 2; and you can reduce the reading one step by dividing the exposure by 1 1/2.

PROCESSING/DEVELOPING THE PLATE

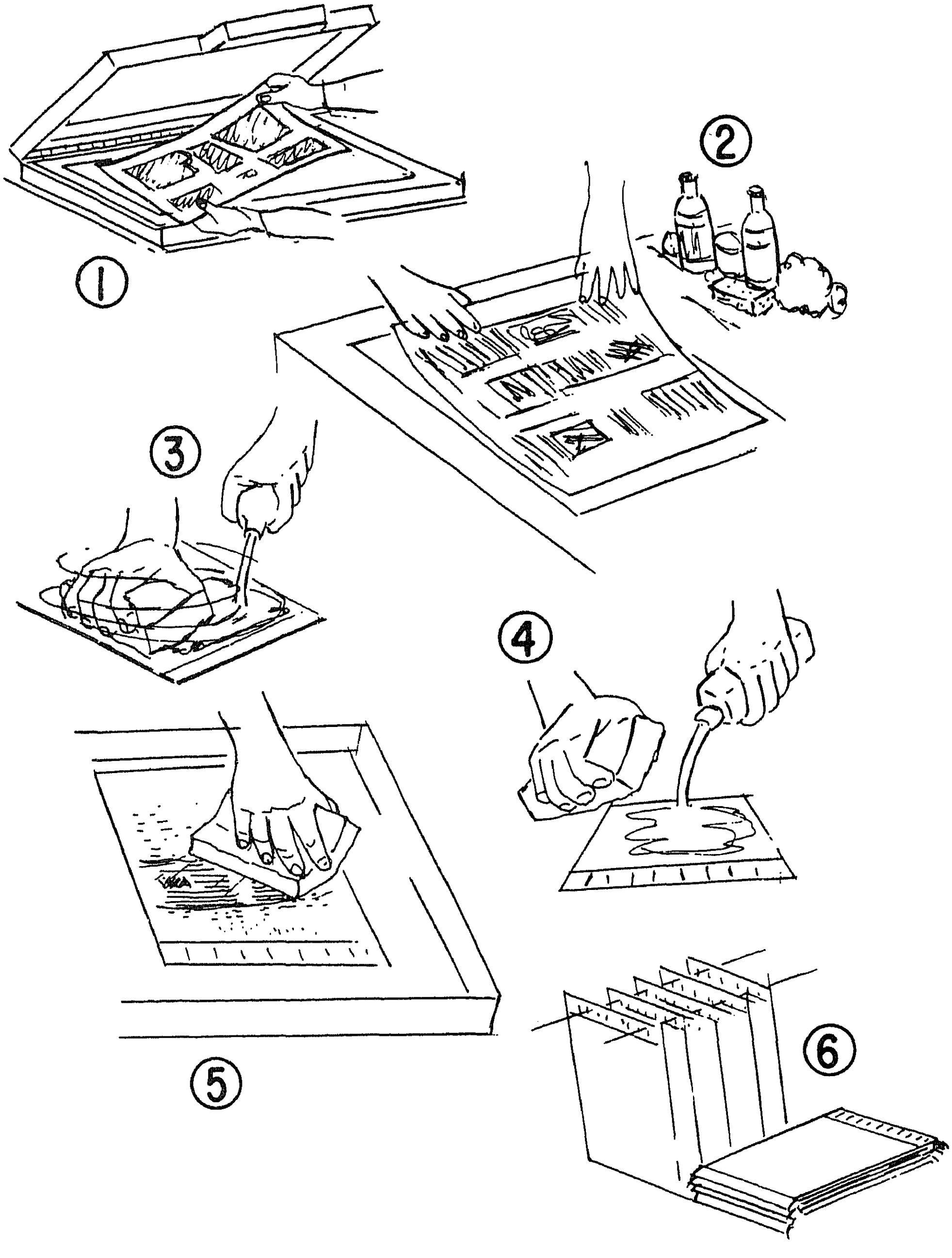
After the exposure is completed, the plate is then ready to be developed. First, you should remove the presensitized plate from the vacuum frame and place it on a table. Then go over it with the proper processing chemicals, following the instructions furnished by the manufacturer. Processing will vary from one type of plate to another, but you will find a set of processing directions in each package of plates.

If the plate is coated on both sides, always place a piece of paper under it before you begin developing it. Also, before you start processing another plate, change the paper. This will protect the second side from your developing chemicals that might seep under the plate during processing. If you have trouble with chemicals seeping under the plate during your plate processing, you should expose both sides of the plate before you process it. You can then develop one side of the plate and turn it over and develop the other in one continuous operation.

In most cases, the exposed plate is first developed with a solution that dissolves the unexposed coating or makes it water receptive. Once this solution has been applied, you can put the plate on the press and run it just as it is. However, if the plate is to be held for some time or if it is to be used for a reasonably long run, it is best to cover the image with a thin coating of lacquer. The lacquer supplies color to the image so that you can check it for defects, and it also lengthens the life of the plate by forming a tough, protective coating over the image area. Do not use too much lacquer. A thin coating will outlast a thicker one when the plate is run on the press.

In addition to applying the lacquer, platemakers also gum the plate with a solution of gum arabic to protect the plate surface. If the plate is not to be used for 2 or 3 days, some platemakers also cover the image with asphaltum.

Although procedures vary according to the type of plate you are using, the following steps are typical of those used in processing a



57.738

Figure 10-12.—Steps involved in processing/developing presensitized plate.

presensitized aluminum plate. Figure 10-12 illustrates the process.

1. Position the flat over the plate in register in the vacuum frame with the readable side of the negatives facing you. Close the frame, turn on the vacuum, and set the timer. Then pivot the frame, and turn on the light source to expose the plate.

2. When the exposure is completed, remove the plate and flat from the vacuum frame and place the plate on a clean, flat surface.

3. Apply the desensitizing solution to the plate with a sponge or pad, using a firm circular motion to remove the unexposed diazo coating. Wipe off any excess desensitizer, but keep the plate surface moist.

of the plate. Distribute it evenly with a clean pad or sponge over the entire plate, using a firm circular motion. Continue developing the plate until the image appears uniform.

5. Wipe off any excess developer and carefully inspect the plate. Rinse the plate with water.

6. If the plates are not going to be used immediately, you can protect the surface of the plates from oxidation and scratches by coating it with gum. Once the gum is dry, the plates may be stored by hanging them or by stacking them and using flat paper slip sheets between them.

PROCESSING A POSITIVE WORKING PLATE

As you know, presensitized plates are available for use with positives as well as negatives. Chances are, you will work primarily with negatives. However, positive plates are sometimes exposed directly from ozalid transparencies, film positives, tracings, form letters, or proofs pulled from type on acetate, and so on. Here the positive areas of the image is transferred to the plate rather than the negative image.

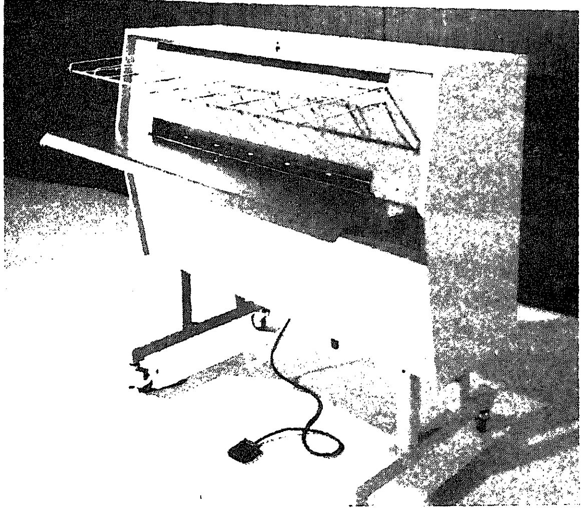
If you have occasion to use positive-working plates, you should follow the exposure and processing directions supplied by the manufacturer.

Some positive- and negative-working presensitized paper plates can be developed with a sponge soaked in plain water. These plates are good for short press runs and are useful when production speed is a major factor.

PROCESSING A SUBTRACTIVE PLATE

Subtractive plates are a prelacquered offset lithographic plate. The lacquer is applied over the entire face of the plate by the manufacturer. During development the lacquer is removed (subtracted) from the nonprinting area instead of being added to the image.

A single processing solution is used, and the same solution can be used for both the long press run and the medium press run plates. After processing, the plate is washed in plain water to remove this processing solution and is then ready for gumming or for putting on the press.



57.631X

Figure 10-13.—The 3M Company's Plate Developing Machine, MR-440.

Machines similar to the MR-440 shown in figure 10-13 will develop plates automatically. You simply feed the subtractive plate into a slot in the machine and step on the foot switch to start the machine operating. As the plate is drawn through the machine, developer is sprayed on the plate, and rotary brushes clean away the coating in the non-image area. The plate is ejected at the top of the machine in 40 seconds, and the machine turns off automatically, ready for the next plate. Next you remove the plate and rinse it in cold water. Then you can squeegee the water off, and the subtractive plate is ready for the press. If it is to be stored for later use, you should gum the plate.

In addition to providing even development over the entire plate, plate processors are faster than developing a plate by hand. They are also more economical because the processing solutions can be recycled and used again. How long the plate developer lasts depends on the size of the area on the subtractive plate from which the coating is removed. You can add a replenisher solution to the developer to prolong its life. Normally, the developer is changed every 2 weeks, and the machine is given a 30-minute cleanup following instructions provided by the manufacturer of your particular plate processor.

Most plate processors will accept plates of various sizes and thicknesses without requiring special adjustments. However, a single processor cannot be used for all types of plates, because, as a rule, the processing solutions are not interchangeable from one type of plate to another.

PLATEMAKING PROBLEMS

Although presensitized plates have greatly reduced the number of platemaking problems, occasionally you will still come up with a bad plate.

Some plate failures are clearly the fault of the platemaker; others stem from the treatment of the plate on the press. If the image is so weak that it literally walks off the plate while the plate is on the press, there is little argument as to which department is to blame. But, if the plate prints properly at the start and runs 3,000 to 4,000 impressions before it begins to go bad, the fault may very well be caused by the press adjustments, the fountain solution, or the ink.

In many cases, making a new and better negative is the best solution to platemaking problems.

Printing Thin Negatives

If the negatives are weak in density, you have a thin negative, and it may be necessary for you to reduce your exposure or place a sheet of white manifold paper over the flat to filter the light. Otherwise, the light will spread the detail for the image and possibly penetrate the semi-opaque portions of the negative to produce toning of the non-image areas.

Watch the highlight and shadow areas when you are printing halftones. (The middletones normally take care of themselves.) Expose the halftones to get as much highlight area as possible without plugging the shadows. But remember that halftone negatives are deceptive. It is not always possible to tell if the dots are opaque unless you examine them under a linen tester. If the dots are fuzzy and semitransparent, the light will cut through their edges and print heavy on the plate. Semitransparent dots will not give a satisfactory image, even if you reduce your exposure time when making the plate. A new negative is the only remedy in this situation.

Inadequate Masking

Inadequate masking of the flat may cause uneven development. If the plate develops more readily in areas where the masking or opaquing and negative overlap each other, you should use a more opaque masking paper to shut out the light completely from the nonprinting areas.

Some shops use a material, referred to as rubylith, for masking purposes. It consists of an acetate sheet with a colored coating which can be cut and peeled off in the image area. Although transparent, this material has the same light-masking qualities as goldenrod paper.

Out-of-Contact Areas

Out-of-contact areas between the plate and negative may allow the image to spread and thicken and cause developing difficulties. Out-of-contact spots are generally caused by insufficient vacuum, thick masking, or heavy opaquing that is too close to the image area. Dirt or lumps on the negatives or plate and kinks or dents in the plate can also cause poor contact. Sometimes out-of-contact spots are caused by trapped air between the plate and the flat. This problem occurs frequently when you are working with ungrained presensitized plates.

You should avoid excessive overlapping of the masking paper. Keep the masking paper at least one-half inch away from the image areas of the negatives. If necessary, you can increase the amount of vacuum when you are printing negatives containing fine detail, or you can let the vacuum pump in the vacuum frame run for 3 to 5 minutes before you make the exposure.

You can keep fine lines from spreading by moving the lamp away from the vacuum frame to prevent diffracted light from undercutting the image. Some operators use a single point of light when printing negatives containing fine detail. In extreme cases, you may temporarily blacken the reflector of the lamp and increase your exposure time.

Halftone Shadow Areas Filled In

If the halftone shadow areas are filled in after the plate is developed, chances are that the negative was too thin and the shadow dots were burned out when the plate was exposed. If time permits remaking the negative and plate, the camera operator should use a longer flash exposure when making the new negative, or you should increase the entire exposure and developing time. Plugging of positive-working plates may be due to underexposure or improper development.

If parts of the negative are out of contact with the plate during the exposure, you will have irregularly defined areas in which the halftone shadows are plugged. You have already seen how to deal with out-of-contact areas.

Defects in Image Areas

If negatives are fogged or if the plate is underexposed, fine lines and highlight halftone dots may drop out on the plate. Since it is impossible to bring up partially exposed lines or missing dots, you should clear fogged negatives with farmer's reducer if time permits. If you are pressed for time, you may be able to get by if you make a new plate and overexpose it slightly to burn through the fogged areas.

Spots in the Nonprinting Areas

If the developed plate shows spots in the nonprinting (non-image) areas, you should examine your negative for pinholes. These pinholes should have been opaqued out after the negative was stripped up. Spots caused by pinholes can usually be honed (rubbed) off of the plate with the snake slip if they are not too numerous or in the image areas.

Plate Scum

Press ink scum does not show up until the plate is put on the press. It is then up to the press operator to determine whether the fault lies with the plate or with the press adjustments. If the scum is caused by a defective plate, it is usually apparent early in the run. The press operator can test the plate by honing off a spot with the snake slip. If the spot stays clean when the press is started again, the problem usually lies with the plate.

Scum may be due to pinholes in the negatives, thin negatives, improper gumming, accidental exposure to light before the plate was developed, or in some cases, to water contamination during developing and fixing.

When you are making the plate, you can reduce scumming problems by taking the following precautions:

- Always check your negatives to see that they are of the proper density and have been opaqued and masked as required. If negatives are too thin, adjust your exposure time or place a sheet of manifold over the flat to prevent broadening of the image detail and toning of non-image areas.

- Do not allow presensitized plates to stand exposed to light for a prolonged period of time before you use them.

- Be sure the gum arabic solution is of the proper consistency when you are gumming the plate. If it is too thick, it will cover the image areas and be difficult to remove. If it is too thin, it may fail to protect the plate properly. You should also be sure that the gum is completely dry before you wash the image out and cover it with asphaltum. If the gum is not dry, the asphaltum may soak through it and adhere to the plate. The asphaltum will be difficult to remove, and if it is not removed completely, it will cause scum when the plate is run on the press.

Blindness

If the image will not accept ink when the plate is put on the press, it is said to be blind. Blindness may be caused by old developer, water contamination during plate processing, or excessive rubbing during development. On some brands of presensitized plates, the image loses its affinity for the ink if the plate is not used for 2 or 3 days after it is developed. You can prevent this from happening by gumming the plate after development and putting the image under asphaltum.

Image Walks Off

If the plate breaks down after the run has started, the problem may lie with the fountain solution, the ink, or the press adjustments. Too much roller or cylinder pressure and the grinding action created by the pigments of some inks are particularly hard on diazo-coated plates.

3M CAMERA-PROCESSOR

The 3M camera-processor, shown in figure 10-14, is an automatic camera and processing unit combined into one machine. It photographs reproduction copy and produces a ready-to-run plate. With this camera-processor you can reduce original copy and make enlargements. It can copy line work and previously screened halftone clippings provided the screen used for the clippings was not finer than 110 lines per inch. The plates produced on this machine are good for 1,000 to 5,000 impressions, and they can be stored and reprinted.

Two types of plate materials are manufactured for this camera-processor: one is a paper-based plate which is exposed and processed within the machine. This paper plate is processed basically the same as an electrostatic plate that uses a powdered toner. After the paper plate is ejected from its processing unit in the lower section of the camera back, it is ready for the press section of your shop. These plates are normally for quick service jobs and jobs that require short runs on the press where high-quality reproduction is not essential.

The second plate material available is made of a polyester base with a layer of silicone and a light-sensitive, silver-halide coating. It is relatively stable and will not stretch or tear. Both of these plate materials come in rolls which are loaded into magazines at the back of the camera. The material is automatically wound down off the roll and cut to plate length after each exposure is made. No film is used in making these plates. The exposure is made on the plate itself, and a positive image is produced from positive copy. After the plate has been exposed and cut, it is caught by a series of rollers which carry it through its processing section and finally eject it through a slot in the machine.

Two processing solutions and two water baths are used for the polyester-based plates. The plate first travels through a tank of developing solution where it turns black on its light-sensitive surface. It then passes into a water bath which removes the silver-halide particles in the unexposed areas, leaving only the blackened image on the plate. From there the plate goes into an activator solution which causes the unprotected non-image areas to become water receptive. The activator solution also removes the silver image from the plate but does not have enough time to act on the image area to make your required image water receptive. The plate next travels into the tank of clear water for the final rinse. After this, it passes between heated rollers which squeegee off the water and evaporate any remaining moisture. The plate then emerges from the machine dry and ready for use in the press section of your shop.

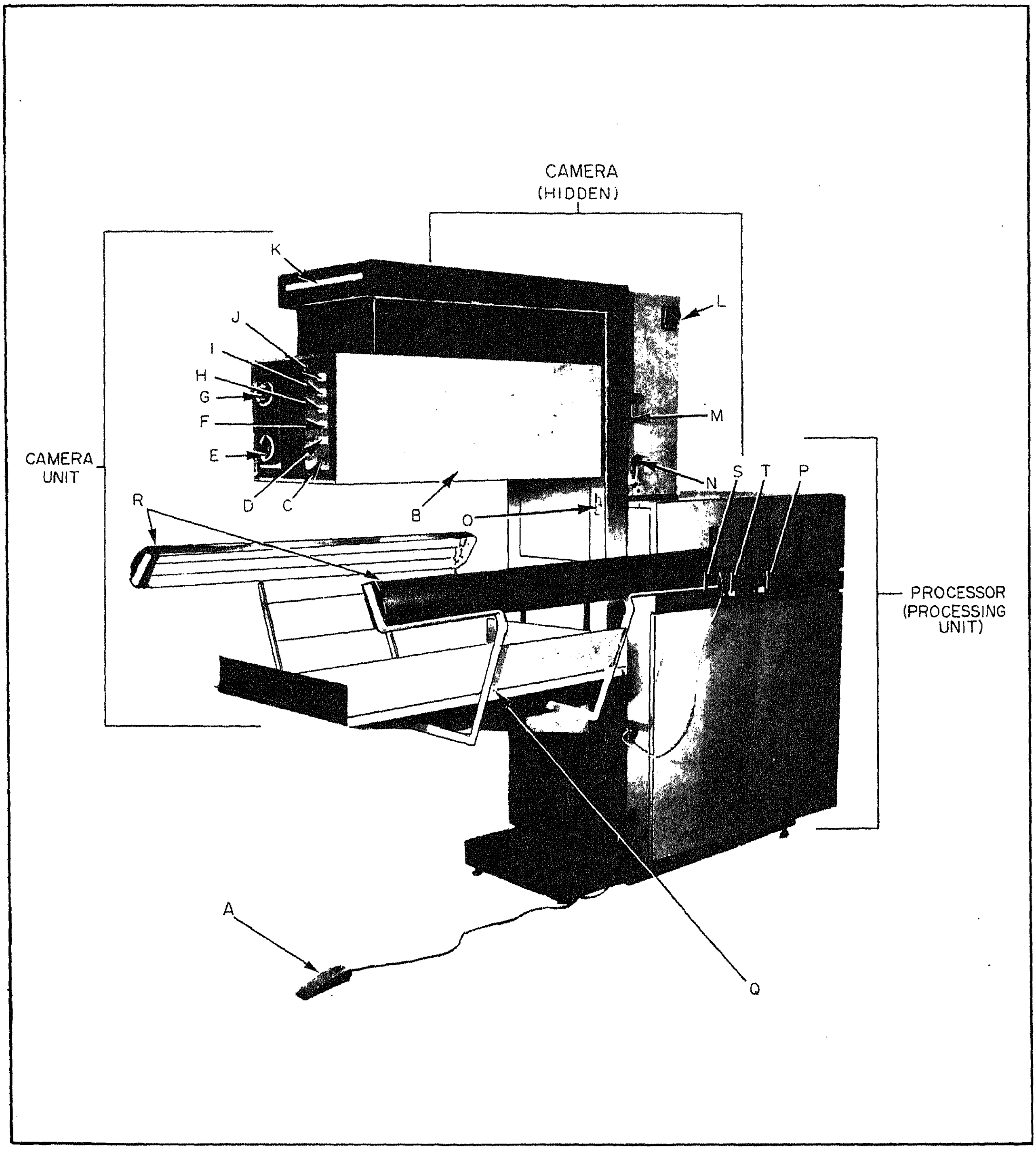
Because a polyester-based plate tends to hug the plate cylinder of your press, the tail end of the plate does not require securing. This means that you can run a shorter than usual plate when the image area is small. For example, you can run a 10- by 11-inch plate on a 10- by 15-inch press. You should always follow the operating and maintenance instructions of the manufacturer when you operate this equipment.

As you can see in figure 10-14, the 3M camera-processor consists essentially of a camera unit and a processor. The camera unit consists of the copyboard, the lamps, the camera, and the magazine which holds the film. The processing unit houses the processing tanks and solutions.

The camera has a movable lensboard which is connected to the magazine by an extension bellows. The lens is positioned at a right angle to the copyboard. A prism is used to bend the image 90° and to reverse it so that it will read forward instead of backwards on the plate. The lens is equipped with a diaphragm with aperture opening settings. It also has a shutter which is opened and closed automatically during the exposure cycle. You can control the length of time the shutter stays open by setting the timer on the control panel.

Operating Controls

Most of the operating controls are located on the right side of the machine or on the control panel at the front of the machine. (See fig. 10-14.) The plate length dial (G) is used in setting the machine for the desired plate length. When you set the length of the plate with this dial, you must also use the crank (L) to move the curtain up or down inside the magazine. (The curtain, as you will see later, masks off all of the plate material except the area to be exposed.) The curtain should be set five-eighths inch longer than the length you have set on the plate length dial. The timer dial (E) is for setting the exposure time. You can set it for any exposure from 1 to 30 seconds by rotating the black knob.



A. Foot switch.
B. Lens on lensboard (hidden).
Open-hinged side panel to reach them.
C. Plate counter.
D. Copyboard position switch.
E. Timer dial.
F. Lensboard position switch.
G. Plate length dial.
H. Camera power switch.
I. Multiple exposure switch.
J. Splice detector switch.
K. Lensboard position indicator scale.
L. Crank for raising and lowering curtain.
M. Magazine.
N. Magazine latch.
O. Copyboard position indicator scale.
P. Drive switch.
Q. Copyboard.
R. Lamps.
S. Developer ready light.
T. Heater switch.

The splice detector switch (J) operates the splice detector. When the detector is on, a buzzer sounds to notify you when the magazine is empty or when the area of the plate material to be exposed has a splice in it. There are normally no splices in a roll of plate material. However, extra material is included in each roll to allow for splices in case one happens to occur. Do not make a plate on a splice area; run it on through the machine as waste.

The multiple exposure switch (I) is used when you are making multiple exposures. You should keep it turned off except when you desire to make more than one exposure on the same plate.

The lensboard position switch (F) is used for moving the lensboard in and out for focusing, and the copyboard position switch (D) is for raising and lowering the copyboard. The lensboard position indicator scale (K) and the copyboard position indicator scale (O) show the positions of the lensboard and copyboard. The settings should be the same on both of these indicators for proper focusing. The plate counter (C) records the number of completed platemaking cycles. There is another counter inside the small door at the back of the magazine. You should set this counter at zero when you load a new roll of plate material into the machine. You can check it thereafter to determine when the roll is running low.

The camera power switch (H) supplies the power to the lamps and camera section of the machine.

The foot switch (A) is used to start the platemaking cycle. When you step on it, the automatic plate system takes over and delivers you a press-ready plate.

The developer-ready light (S) comes on when the developer has reached the proper temperature. The heater switch (T) is for turning on the heaters, and the drive switch (P) is for turning on the power for the processor rollers. The indicator lights to the left of the switches come on when the drive and heater switches are turned on. It takes a few minutes for the processing solutions to reach the proper temperature at the beginning of the day. You should keep the heater on at all times during the day, but you can turn off the drive switch when you are not actually processing plates.

Copyboard

The horizontal copyboard (Q) shown in figure 10-14 has a glass cover which is opened from the front. The bed of the copyboard is white, and it is marked with a series of blue reference lines in the form of rectangles. These rectangles are marked according to the amount of reduction or enlargement required, and you can use them as an aid in positioning your original copy and determining the settings for your copyboard and lensboard.

For example, if your copy is to be reduced 45 percent, you should position it in the rectangle marked 45. If it is to be enlarged to 150 percent, you should place it in the rectangle marked 150 and if it is to be shot the same size, you should place it in the rectangle marked 100. Position the copy against the top line of the rectangle and center it from side to side within the area.

As a rule, the reference lines will not photograph. However, they may show up if the plate you produced is underexposed.

Focusing

Proper focusing depends not only on the placement of the original copy in the proper rectangle on the copyboard (Q), but also on the required positioning of the lensboard (B) and copyboard. For example, if your copy is to be reduced 45 percent, you should place it in the rectangle marked 45 on the copyboard and then move the copyboard and lensboard until they both register 45 percent on the copyboard (O) and lensboard (K) indicator scales.

You can raise or lower the copyboard with the copyboard position switch (D) shown in figure 10-14. The copyboard position indicator scale (O) shows the amount of enlargement or reduction. If the copy is to be reproduced the same size, move the copyboard until the indicator is at the 100-percent mark. If the copy is to be reduced 45 percent, move the copyboard until the indicator is at the 45 mark, and so on.

You should use the lensboard position switch (F) to set the lensboard at the same percentage as the copyboard. As you can see in the illustration, the lensboard position indicator scale (K) is located just above the control panel at the front of the camera.

Books or other thick originals may prevent you from closing the cover of the copyboard. In this case, you should place the original on top of the cover and then place a clean piece of glass over the original to keep it from curling. If the edges of the copy cast a shadow, you will need to overexpose your plate to eliminate the shadows by increasing your exposure.

If the thickness of the original causes the image to be out of focus, you should lower the copyboard so that the original copy will be at the height the copyboard would normally be for proper focus. If focusing is still a problem, you can open the back of the camera and focus visually on a ground glass. (The ground glass supplied with each machine can be inserted into the machine if it is needed. It is generally used only for lining up the focusing scales when the machine is first installed; however, it can be used for focusing in cases like the one just mentioned. It should be removed from the camera and properly stored at all other times.)

To use the ground glass, you should roll the curtain all the way down with the crank (L) shown in figure 10-14. Then open the magazine (M) and place the ground glass frame over the locating pins and snap them into place on the bellows rack. Set the lens aperture opening at f/10, and set the multiple exposure switch (I) and timer dial (E) to 30 seconds. Press the multiple exposure switch to the ON position. Then depress the foot switch (A) and an image will appear on the ground glass for 30 seconds. Step on the foot switch again, if necessary, so that you can see the image as you bring the camera into focus. You can focus the image by moving the lensboard or copyboard slightly. Do not raise the copyboard above the 100-percent position, however. The lamps may be damaged if the copyboard is raised too high when the magazine is open.

To aid you in focusing, you should dim the room lights and use a linen tester to examine the image on the ground glass.

Camera Lamps

Again in figure 10-14, you can see that there are two camera lamps (R) which travel along with the copyboard. Each lamp has prefocused bulbs. Diffusing grids are provided on each lamp assembly. These lamps have reflectors at the end of the copyboard to help balance the lighting.

It is not necessary to adjust the lamps except when you are photographing large copy. In this case, you can move them out to provide more even illumination. The lamp frames are notched to lock in the proper *in* and *out* positions.

The bulbs will burn for approximately 2,400 hours. However, they lose intensity as they are used, and it is necessary to compensate for this by increasing the exposure slightly. When you reach the point that excessive exposure time is required, you should change all the bulbs at once. Be sure to consult the operator's manual supplied by the manufacturer before changing the bulbs or doing any maintenance on shop equipment.

Making the Exposure

A 10- to 20-second exposure at f/32 is generally used for black-and-white copy of good contrast, such as typed, printed, or written material. You may need to increase the exposure, however, to drop gray or blue from the background; drop or reduce shadow lines; expose through an acetate overlay, Zip-A-Tone, or filters; sharpen prescreened halftones; expose smudge copy; or to enlarge the original copy 150 percent.

You can decrease the exposure time to copy a light blue or gray image, hold or broaden thin lines, or reduce the original 45 percent.

Some camera operators photograph a gray scale along with the original copy, positioning it so that it will print on the tail edge of the plate but not on the press sheet. If you use a gray scale, you should shoot for an open step three or four for normal copy. If the background of the copy is dark, it may be necessary for you to increase your exposure to get a satisfactory image. And if the image on the copy is very light, it may be necessary for you to reduce your exposure and drop down to an open step two on the gray scale. In this case, when you run the plate on the press, it may not hold up for a long press run because of the weak image. Therefore, if you have a plate with a weak image and the job requires a long press run, you may need to make more than just one plate.

Multiple Exposures

You can expose two separate pieces of copy on the plate at the same time if the exposure requirements are the same for both pieces. This can be done by simply placing the two pieces on the copyboard at the same time. If they are not placed at the same time, then you must use multiple exposures for the copy. To achieve multiple exposures, you should turn on the multiple exposure switch (I) shown in figure 10-14. The multiple exposures will prevent the plate from advancing until after you have completed the separate exposures.

Use black paper to mask out all the copy except the area that is to be exposed. Shift the masking, as necessary, until all exposures have been made. Then turn off the multiple exposure switch to advance the plate through the machine where it will be processed and ready for the press.

Filters

No provision is made for mounting a filter over the lens; however, you can place a 2-mil polyester filter sheet over the original copy (under the copyboard glass) and photograph the copy through it. A yellow filter sheet will often improve the appearance of copy that is gray, weak, or yellowed with age.

Magazine

As you can see in figure 10-14, the magazine that holds the roll or rolls of platemaking material is located at the back of the camera. You can release the magazine latch (N), and open the magazine when you are changing rolls. Check to see that the copyboard is not raised above 100-percent setting before swinging the magazine door open all the way; you may damage the lamps if you open the door when the copyboard is too high.

The magazine is equipped with rubber rollers for moving the plate material and with a mechanism which cuts the rolled plate material to the selected plate length after each exposure. The width of the plate depends on the width of the roll, but you can control the length of the plate by setting the plate length dial (G) to the number that corresponds to the desired length.

Both types of plate materials come (wound emulsion side out) on rolls. These rolls are available in varying widths. The spool holders in the magazine are adjustable sidewise to accommodate rolls of different widths.

The magazine has a curtain to protect the plate from room light when the magazine is opened or to mask off a portion of the plate so that no exposure will be made. The crank (L) is used for raising and lowering this curtain.

To keep from exposing the plate material, you should lower the curtain by turning the crank clockwise as far as it will go before you open the magazine. You should raise the curtain by turning the crank in the opposite direction when you are loading a new roll into the camera magazine.

Detailed instructions for loading new rolls of plate material in the magazine can be found in the operator's manual. These instructions should be followed exactly to avoid waste of plate material and/or damage to the camera-processor.

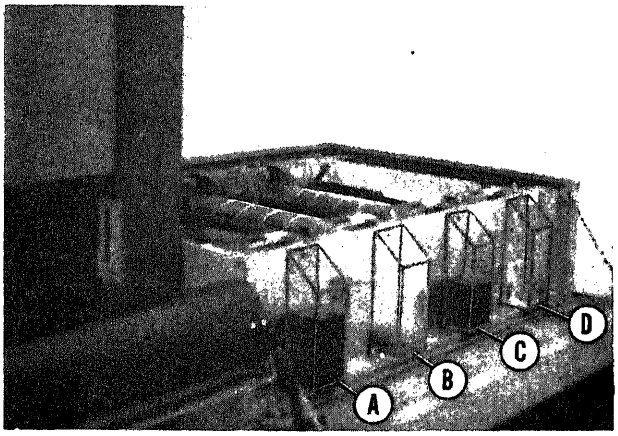
Processing Unit

The processor unit for the polyester base plate material consists basically of four tanks. (See fig. 10-15.) It requires no plumbing and operates on 110-volt current. It is specifically designed to work with the 3M camera; however, it can be operated independently as a processor for other camera units, such as the Itek Platemaster.

After the exposed plate is cut to the proper length, it is automatically fed into the processor where gear-driven rollers move it into a tank containing 3M Camera Plate Developer, which should be kept heated to 80°F. After the plate leaves the developer, it passes into a rinse tank where water heated to 110°F is sprayed onto it by nozzles contained in the tank.

From there, it passes into another tank containing 3M Camera Plate Activator (at room temperature); and from there, it is carried into a tank of plain water (at room temperature) for the final rinse.

After leaving the final rinse tank, the plate passes through the heated rubber rollers which remove excess water and evaporate any remaining moisture. The plate is then ejected from the machine into a tray, dry and ready for the press. You can use this plate just as it comes from the machine, or you can wipe it with 3M Camera Plate Starter Solution and put it on the press while it is still wet.



A. Spout for developer tank.
B. Spout for wash tank.
C. Spout for activator tank.
D. Spout for wash tank.

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Figure 10-15.—Feeder spouts leading to the developer, activator, and wash tanks to their left.

paper plates of the camera processor works the same as the electrostatic platemaker. After these plates are ejected from the back of the camera magazine, they must be premoistened with a starter solution just before they are run on your offset press.

Inspecting the Plate

When the polyester plate emerges from the processor, you should check it by holding it at an angle to the light. If the fine lines in the image are too heavy, make a new plate, using more exposure. If the lines are too thin and the plate looks washed out, make a new plate using less exposure.

If you prefer, you can moisten the plate with 3M Camera Plate Starter Solution before inspecting it. This solution will make the inspection somewhat easier.

Because the image is black on the surface, it is easier to inspect the paper plate after it emerges from the processor. Here the image is produced from a deposit of toner. Image improvement on the plate can then be made, if necessary.

The back of either plate should be wet with water before it is put on the press. The water makes it hug the plate cylinder. This is particularly important when only one end of the plate is fastened to the cylinder.

Making Deletions

You can make deletions to the plate after it is put on the press by raising the ink rollers and allowing the press to run with the water rollers on until all the ink has run off the image. Then stop the press and dry the plate. Remove any remaining ink from the area to be deleted with fountain solution. After this, apply 3M Camera Plate Deletion Fluid to the area to be deleted. Dry the area and go over it with fountain solution.

If a deleted area picks up the ink when you start the press again, chances are that you did not allow the deletion to dry thoroughly or you may after drying it. Repeat the process to clean it up.

Filling the Processor Tanks

You can reach the drains and filling spouts to the four processor tanks by opening the side covers of the processor. Be sure all the drain valves are closed before you attempt to fill any of the clean processor tanks. If the tanks have been standing empty for a time, flush them with clean water to get rid of dried residue before filling them.

Make sure that the rollers are intact and in all four tanks before you fill the first tank. Then pour enough developer into the tank to fill it to a point midway between the two red lines on the plastic spout (A) shown in figure 10-15.

Pour warm water into the filling spout of the second wash tank (B) until it reaches the level between the two red lines on the spout. Then pour activator into the spout (C) and water into the spout (D), filling the tanks until they reach a level between the red lines on each spout.

Securing the Processor

At the end of the day, you should shut off the power to the processor and the heaters to prevent premature exhaustion of the developer. You should lower the magazine curtain to prevent exposure of the plate material and to open the magazine to keep moisture from forming inside the camera. (You should open the magazine any time the processor is unplugged.)

Drain the tanks if the processor is to be idle for a week or more. Then clean all the tanks completely and fill them with water. You should be able to save the activator from the tank because of the long life of the solution.

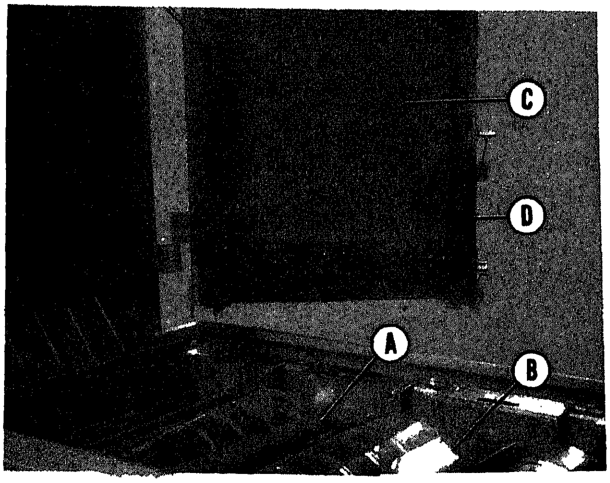
Daily Maintenance

At the beginning of each day, set the copyboard for less than 100 percent. Then roll the curtain (C), as shown in figure 10-16, all the way down and open the magazine (D). Be sure the drive switch of the processor is off. Open the side panel and lift the top away to expose all the working parts of the processor necessary to daily maintenance operations.

Open the drain valve and drain out 1 quart of developer. Replace it with a quart of fresh developer. You can drain the developer into a 5-gallon container. You should not flush the materials drained from any of the four tanks directly down the drain even with plenty of water because of the chemicals involved. You should be aware of proper disposal procedures for all chemical solutions you are using.

Next remove the carry-over plates (B) that direct the plate material from one tank to another. This will expose the rollers (A—the figure shows only one of these rollers) in each of the four transport station roller units. Clean these rollers with a lint-free cloth. Jog the processor drive switch off and on intermittently to move the rollers around for cleaning. After cleaning, replace the carry-over plates.

You should also check the levels of the solutions in all of the processor tanks. If they are not up to the proper levels, add the proper solutions or water to bring them up. (In each case, the solution level should be between the red lines on each spout.)



A. Transport station roller.
B. Carry-over plate.
C. Curtain.
D. Magazine (in open position with curtain rolled down to prevent exposure of plate material).

57.636

Figure 10-16.—Processing unit with top casing removed.

Finally replace the covers and close the magazine. The processor is now ready for operation.

Periodic Maintenance

The processing solutions become exhausted with age as well as use. Therefore, you should drain the developer and rinse tanks at the end of every 2 weeks or after 1,000 plates have been processed, whichever comes first. The activator solution lasts longer than the developer, but it should be changed every 6 months or after each 15,000 plates have been processed.

Flush the tanks; then fill them with warm water. Turn on the drive switch and allow the rollers to run for a couple of minutes. Then turn the drive switch off again. Remove and clean the carry-over plates. Next remove the rollers comprising the transport stations by disengaging the twist clips that hold the units in place. Lift them out and wipe them clean in the sink. Do not use abrasives, scouring powder, or detergents on them. A nylon scouring pad will provide sufficient scouring.

After this, drain the warm water from the tanks and flush them with warm water until all residue is washed away. Scour with a nylon pad if necessary.

Next, replace and secure the transport stations rollers, being careful to get each one in its proper place. Once this has been done, you can snap the carry-over plates back into position.

Finally refill all tanks to the proper levels. You have just seen that the activator tank does not require draining and cleaning except after every 15,000 plates. In the meantime, however, you can recharge the activator with an occasional addition of additional solution to bring it up to the proper operating level.

You should check all solutions frequently. If the water in the first rinse tank becomes dirty, it may foam and interfere with the spraying action. If this happens, you should replace the wash immediately. You may be able to use 3M Anti-Foam to neutralize the foam if it is caused by a high hourly volume of platemaking. The final wash should be changed if it becomes yellow or full of sediment. Do not use Anti-Foam in this tank.

General Maintenance

You should go over the copyboard glass and bed at regular intervals with a soft rag and mild soap. Dirt and scratches on the copyboard glass and/or the bed can cause shadows which could photograph with the copy. Do not rub the bed of the copyboard excessively as this may remove the blue guidelines.

Check the lens assembly at regular intervals. If it is necessary to clean the prism, use a camel's hairbrush or wipe it gently with lens paper. If a more thorough cleaning is required, use lens cleaning solution and a soft cloth. Be careful not to scratch the surface of the prism or change its position.

Once every 6 weeks, you should lubricate the copyboard and cover glass pivot and slides, drive screw, slide and slide rollers; the lens assembly rail and drive screw; the magazine motor, rack, knife, slide, pivot, advance shaft bearings, and clutch activating mechanism; and the processor motor, chain, chain rider sprocket bearings, and the chain backup blocks. Detailed instructions for proper lubrication and maintenance are found in your operator's manual provided by the manufacturer. You should, of course, follow all of these instructions for the proper care of this equipment.

METALPHOTO

Metalphoto plates can be produced economically and quickly. They can serve as identification plates for doors, hatches, or compartments aboard ships, and equipment operation instructions—to name a few uses. Using the Metalphoto process, you can make many other types of signs or plaques on light-sensitive aluminum plates in your lithographic print shop. This process replaces the more expensive and time-consuming machine-engraving or acid-etching processes to produce information on a material that will stand up for an extended period of time.

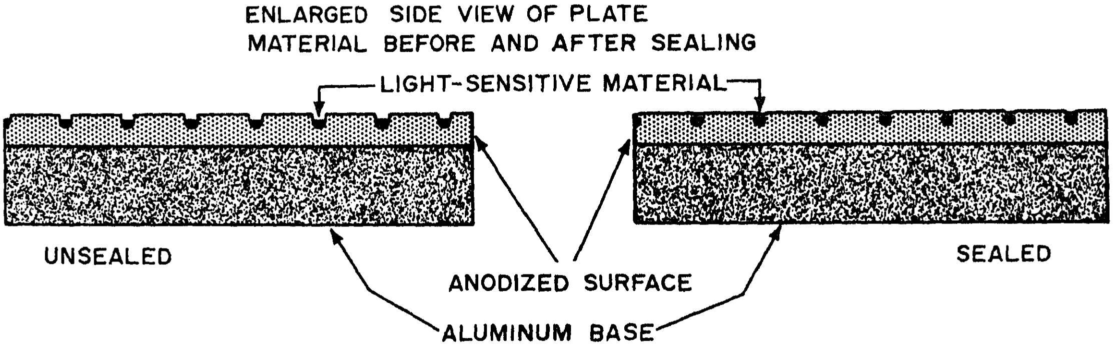
Metalphoto plates processing equipment and chemicals are available through the Navy Supply System. The plates may be ordered in many sizes, thicknesses, and colors. Gloss, matte, or satin types of Metalphoto plate surface finishes are available.

As you can see in figure 10-17, Metalphoto plates consist of an aluminum base which has a light-sensitive coating impregnated into a porous anodized surface. These plates are available with the light-sensitive coating on either one side or both sides. After the plates have been exposed and processed, the photographic image is permanently sealed within the metal. This produces an image that is as durable as the metal itself. Metalphoto plates may be done in many colors and many combinations of colors.

HANDLING AND STORAGE

As with most kinds of photographic emulsions, Metalphoto plate emulsions must be handled and processed under safelights. The coating on the plates is color-blind to red and yellow light, so you may use either of these colors of safelight in the processing area. To avoid unwanted exposure when you are working with Metalphoto, you should keep its emulsion at least 4 to 6 feet away from even the safelights.

Do not remove a plate from the package until you are ready to use it, and reseal the package carefully to prevent stray light from hitting the



Metalphoto is a registered trade mark of Horizons Research Incorporated unexposed plates. If you expose several plates in a group and plan to process them later, interleave each plate with paper so the surface of the plates won't become scratched or marred by each other.

You must keep the working area and processing equipment clean to produce good quality Metalphoto plates. Pay special attention to the negative and vacuum frame used to expose the plates. They can pick up dirt or chemicals and transfer it to the plates.

All Metalphoto processing chemicals and the intensifying solution must be stored and used in glass, plastic, or rubber containers. The plates may be processed in darkroom trays; however, the sealing step should be done in an aluminum or stainless steel tank. You should check the manufacturer's instructions to be sure that all of the processing solutions are stored and used in the proper containers.

For best results, the temperature of the working and storage areas of the plates and processing solutions should be maintained between 68° and 75°. To maintain these temperatures, you will often have to air-condition the area.

PRODUCING METALPHOTO PLATES

High contrast line or halftone negatives produce the best results with these plates. You should use a contact frame or vacuum frame to get proper contact between the unexposed plate and the negative. You can use the platemaker exposure unit in your shop to double as the vacuum frame exposes the Metalphoto plates. Of course, you must rig the required safelights in the area for it to be used with Metalphoto.

A light source high in ultraviolet light must be used to expose the plates. Since light sources vary in intensity, you will have to make a series of test exposures to determine the correct exposure time with your equipment. Normal exposures for various types of light sources could vary from 2 to 30 seconds.

Developing and Fixing

You can develop and fix Metalphoto plates in trays, like sheet film, or a special processor can be used to automatically develop and fix each plate.

These processors can handle all thicknesses and sizes of plates without any adjustments. Before use, it must be filled with the developer and fixer solutions and then allowed to run for about 30 seconds to allow the solutions to become distributed throughout the roller system. The plates are fed into the processor with the exposed side down. In less than a minute, the plates emerge from the processor with the image developed and fixed.

If you are processing Metalphoto plates in trays, you should thoroughly wet the plate with water before placing it in the developer. Then submerge it quickly into the tray with a sliding motion with the exposed side of the plate facing you. Normally, the plates are developed 3 to 4 minutes with a slight tray agitation.

When you have completed developing the plate, rinse it for 1 minute under running water. Then immerse it for 1 minute under running water. Then immerse it in the fixing solution for 2 minutes with some tray agitation. After fixing the plate, rinse it again for 1 minute in running water.

After the plates have been fixed, they may be handled under normal lighting. Inspect each plate for stains or other markings.

Stain Removal

For removing spots, fingerprints, or chemical fog from Metalphoto plates, you should prepare a stock solution consisting of 1 gram of potassium ferricyanide to each ounce of water. From this, prepare a working solution consisting of 1 ounce of stock solution diluted with water to make 32 ounces of working solution.

Stains and fog must be removed immediately after the plate is fixed and before the plate is intensified. A plate requiring this cleanup should be transferred directly from the fixing bath to a tray containing the working solution of potassium ferricyanide. Light, overall fog generally disappears in 15 seconds. If the plate has not cleared fully at the end of this time, rinse it under tap water and return it to the fixing bath. This process of clearing and rinsing can be repeated as necessary.

To remove spots or stains locally after fixing, saturate a cotton swab with the stock solution of potassium ferricyanide and rub the affected area lightly until the area is clean and rinse it under tap water. Then bathe the entire plate in a tray of working solution to ensure a uniform background and rinse again. You can remove marks or mars caused by plates rubbing together during processing by scrubbing the area lightly with a household scouring powder after the plate has been sealed.

Intensifying

After the plates have been developed and fixed, the image is a sepia (brownish) color. To obtain a dense black image, it's necessary to completely immerse the plates in another chemical solution, called Metalphoto Image Intensifier. Intensifying of Metalphoto plates is done after fixing and when all unwanted stains and marks have been removed. The plates should be kept in the intensifier until the image appears blue-black to your eye. The total time of intensifying will vary from 1 to 5 minutes, depending upon the strength of the solution. It is best to work in a well-lighted area while you are intensifying the plates so you can tell when the image is completely blue-black.

You have seen earlier that you cannot use metal containers for the intensifier solution. A glass, plastic, or rubber container must be used.

Sealing

When sealing the Metalphoto plate, you close the porous surface of the plate. It is best to suspend the plates vertically in the sealing bath. Plates sealed in a tank should be kept separated by placing clothespins or metal clips along the sides of the tank. If it is necessary to seal a plate flat in a tray, be sure the image side is up. Never seal two plates in a tray at the same time.

For maximum durability and shorter sealing time, you should use Metalphoto Sealing Additive DSA-300. Mix the sealing additive with distilled or deionized water; heat the solution to between 205 °F and 212 °F and immerse the plate in this solution for a minimum of 5 minutes. If the additive is not available, you should immerse the plate for a minimum of 30 minutes in distilled or deionized water heated to the boiling point throughout the period.

Rinse all traces of the sealing additive from the plate as soon as it is removed from the sealing solution. If the sealing additive dries on the plate, scrub the plate lightly with a damp, soft cloth and a common household scouring powder before you attempt to polish it.

Polishing

After the plate has dried, you can finish it by polishing it with any commercial or household polish or wax (liquid or paste). You simply apply the selected polishing agent, rub it in, let it dry, and then buff the Metalphoto surface until it is clean. This step will improve the looks of your final product.

SUMMARY

Lithographic plates are produced (made) from the flats you produced in stripping. These plates will work on the press because of the principle that grease (ink) and water do not mix. Lithographic plates have a porous (grained) surface which hold water while the image placed on the plate repels water and accepts ink as the plate rotates on the press.

There are a few other types of plates but surface plates are more commonly used by the Navy. Much of your work will involve working with presensitized plates which are available for use with either negatives or positives. These plates have a light-sensitive coating which must be developed after exposure and fixed when you are working with positives.

An additional plate is available with a special diazo coating which will increase the life of the image on your press by as much as 100,000 copies. Using the same procedure as the one used for presensitized plates, you can process and run the plate. After you run the press sheets, you can save the presensitized plates so they can be used again.

Direct-image plates do not have a light-sensitive surface. These plates, however, will accept an image when you type, draw, or rule on them. They can also be fed through copying machines and the image will reproduce on them through the toner transfer process.

Another type is the camera-direct plate. This plate can be produced by either projecting the image with a projector similar to that of a photographic enlarger or a camera. Here, the plate is exposed directly from your original copy, eliminating your stripping operation. Then, in the camera's processing unit, the plate is automatically fed into the processing steps. When all the processing steps are completed, the plate is ejected from the machine and ready for use.

Electrostatic plates are produced when masters are fed through copying machines and their coating receives an electrical charge. When the coatings are exposed to light, they loose that charge in the non-image area. Then a black powder toner is attracted to the image area of the plate that is fuzed to the plate surface and still has a charge. Now a visible image has been created on the electrostatic plate which you can run on your press.

Transfer plates are another nonlight-sensitive plates and require a special negative paper. After their exposure, the negative and plate are fed into the developing solution. After development, the negative is peeled from the plate. Before being run on the press, a lacquer is rubbed on the plate and the plate is dried.

Driography plates are presensitized plates and do not require water on the press. They are exposed and then developed in a one-step dry-plate developer, washed, and dried. When developing Driography plates, you should work on a flat, smooth, and cool surface. Pour a liberal amount of developer into the center of the plate. Use a moistened developing pad to distribute the developer. When you notice a change in the color of the plate image, increase the pressure on the pad in a circular motion to remove the coating from the image area. When you have a clean image area, flush the plate surface with water and then blot it dry.

Since the plate is run on the press, it needs no water. You do not even need to premoisten it. However, you must use special driographic inks. At the end of the press run after the ink has been removed from the plate, you can save it to be used again.

To avoid unwanted plate exposure when you are processing presensitized plates, you should work under a yellow light. These plates should be handled carefully to avoid plate surface damage, buckling, and additional exposure both when working with the packaging and during processing. Your stock of plates should be stored in a cool place and rotated according to the shelf life of each plate.

When the plate is exposed with the image, the flat is placed over it and a light strikes the light-sensitive surface. Along with the required image of the flat, you may also expose the image of a sensitivity guide (gray scale) in the margin of the plate to later aid you during plate development.

After exposure, you can develop the plate after the flat is removed from it, and the plate is laid on a table. If both sides of the plate have been exposed, place a clean sheet of paper under each plate to protect the second side from the developing chemicals. Developing (processing) solutions instructions are supplied by the manufacturer in each box of plates. However, in most cases, the first solution used will dissolve the unexposed area of the plate coating. After that solution is used, the plate could be run on your press. But, in most cases, a lacquer is applied next to give color to the image so it can easily be inspected. This lacquer also strengthens and protects the image. Also, to protect the plate, you should coat the surface with gum arabic.

You may have a chance to expose positive-working plates with a positive image. For exposure and processing directions when working with positive-working plates, you should check the manufacturer's instructions that are packaged with the plates. Some of these plates require only a sponge and some water to process them. Such plates, however, are generally good only for short press runs.

As you use the required chemicals to process a subtractive plate, the lacquer used during plate development is subtracted from the non-image area after the plate is prelacquered. These plates can be processed either by hand or in machines. If the plates are not to be run off the press immediately after processing, you should rinse, dry, and gum them.

Even with high-quality plates, chances are you will experience platemaking problems. Some of the problems might be noticeable when you inspect the plate right after its production; whereas, other problems might develop when the plate is on the press.

Platemaking problems that occur from thin negatives might be solved during exposure by cutting your exposure time or by using a piece of thin paper between the light source, the flat, and the plate. This paper would diffuse the light so it would perhaps not penetrate the weak semi-opaque areas of your negative. For halftones, you need to retain as much of the highlight area as possible. Check both the negative and the result of your exposure with a linen tester. If you are working on a plate and your original copy is inadequately masked, it may cause uneven development. The solution then to this problem would be to use a denser masking paper or a color that the film would register as if it were solid black.

If you are trying to make a plate and your negative is out of contact with your plate, the image you need will perhaps spread during exposure. Any one factor or a combination of factors could cause this problem. If possible, rearrange your lights before exposing your plate. Try moving the light further away from the vacuum frame to keep the lines of your image from spreading on the plate.

When you are developing your plate, if the shadow areas of the halftone work is filled in, the problem might be in the negative. Therefore, it is probably best to reshoot it. You should also reshoot it in case there are defects in the image areas. However, in some cases, you may be able to treat the negative with farmer's reducer or overexpose the plate to burn through some areas.

Spots on the plate in the non-image areas could be caused from pinholes in the negative. These spots can usually be honed from the plate surface but they should have been opaqued out of the negative in stripping.

On the press, ink scum may show up on the plate. You can check this by honing the spot of scum from the plate and seeing if the area stays clean. You can reduce scumming by checking negatives, adjusting plate exposure times, using manifold paper over the flat, avoiding unwanted exposure of the plate during handling, and preparing the plate in the required method before running it on the press.

Plate blindness may be caused by old developer, water contamination of the plate service, or excessive rubbing during development. If your image walks off the plate, it could be problems with the fountain solution, ink, or press adjustment.

The 3M camera-processor combines the camera and the processing unit that develops, washes, and dries the plate. This is a quick and effective system which eliminates the stripping operation. Two types of plates are produced by this machine. One plate is made with a paper base, and while it is produced quickly, it does not produce the quality in the final printed product that can be obtained from the second type of plate. The second plate is made with a polyester base and can produce large numbers of copies with halftones on the press. This camera-processor has two main positions for most of its operating controls—one at the front and the other at the side of the machine. You should follow the manufacturer's operating and maintenance instructions when working with this equipment.

Since you might be required to produce identification plates for doors, hatches, or compartments aboard ship, you should know that the Metalphoto process is very similar to the process of producing lithographic plates. These Metalphoto materials replace the more expensive and time-consuming engraving or acid-etching processes. The Metalphoto plate has a light-sensitive coating on one or both sides, and they come in a variety of sizes, colors, and finishes. You should handle Metalphoto plates under red or yellow safelights. When you are storing and handling these plates, the area should be between 68 °F and 75 °F. The offset press is presented in the next chapter.

CHAPTER 11

THE OFFSET PRESS

A designated section of this chapter contains information required for LIC candidates only. The designated section will be prefaced "For LIC candidates only." LI3, LI2, and LI1 candidates DO NOT have to read this designated section. However, junior LIs serving as LPOs may find the information of interest.

As a Navy Lithographer, you will have work that requires you to understand the different kinds of offset presses and how they operate. This chapter discusses various offset presses as well as their operation so that you, as the press operator, can run your required press sheets.

As you use the lithographic offset plates produced in platemaking with your offset press, you will move even closer to the completion of your finished printing job. The lithographers' offset press, although only a step in the process of doing the job, is truly a major step in the production of high-quality offset printing jobs.

Several kinds of offset presses discussed in this chapter are not used in Navy lithographic shops. However, you should have a basic understanding of the various presses as a background for your lithographic training.

KINDS OF PRESSES

Offset presses are generally designated by size, model, and manufacturer or distributor, and whether they are single or multicolor, whether they print on one side or on both sides of the press sheet, or whether they are sheet fed or roll fed.

FOR LIC CANDIDATES ONLY

The following information on kinds of presses is required for LIC candidates only. LI3, LI2, and LI1 candidates are not required to read this designated section. However, junior LIs serving as LPOs may find the information of interest.

SIZES AND TYPES OF PRESSES

In the Navy, you are likely to come across the 23- by 36-inch and the 19- by 25-inch Harris presses; the A. B. Dick Models 350, 360, 385, and 9835; the Multilith Models 1330 and 1360; and the Heidelberg series offset presses.

The list is not all-inclusive. There are many other good offset presses, manufactured by several different companies, that you may come across. Since it is impossible to cover all types of presses in a manual such as this one, the detailed discussion in this text is limited to those presses that you are most likely to come across in your work.

Small offset presses are sometimes called duplicators. This is because they are used as office equipment as well as in lithographic shops.

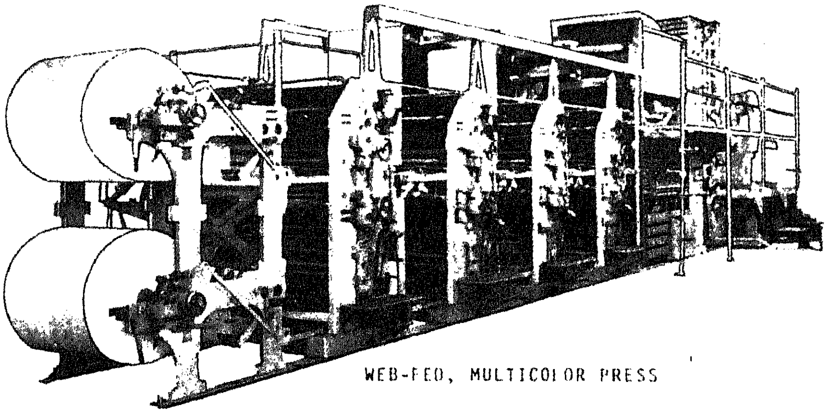
WEB PRESSES

Printing presses that are designed to feed paper from the roll instead of feeding separate sheets are known as web-fed presses. Once the web of paper is threaded through these presses, all printing operations are continuous. Therefore, these presses are capable of turning out work at an enormous rate of speed (see fig. 11-1).

Except for the paper-feeder system, the web presses operate on the same principle as other offset presses. However, there are no web-fed presses used in the Navy today.

SHEET-FED PRESSES

The presses found in the average lithographic shop are sheet-fed. These presses are built primarily to pick up individual pieces of (paper) stock from the feed table and deliver them, one at a time, down the feedboard to the printing unit. Usually the sheets travel down the feedboard singly with a slight gap or space separating the tail of one sheet and the head of the next one. This is known as single-sheet feeding or successive feeding.



57.214

Figure 11-1.—The first American roll-fed press was designed and built by J. F. Webendorfer. It was called a "web" press—not because of the inventor's name, but because it was fed from a web of paper.

On some sheet-fed presses, the sheets overlap one another as they travel down the feedboard, as shown in figure 11-2. This is known as stream feeding. When the sheets of stock overlap in this manner, it is possible to run them down the feedboard at a slower speed than that required for single-fed sheets. This makes for better register, because at slower speeds, the sheets are less likely to bounce away when they strike the register guides at the end of the feedboard. It also eliminates the necessity for using a slowdown mechanism (a device used on some presses to slow down the sheets momentarily before they reach the guides). All Navy presses are sheet fed or stream fed.

MULTICOLOR PRESSES

Presses capable of printing more than one color in a single run are known as multicolor presses. These presses consist essentially of a series of single printing units combined into one machine. See figure 11-3. However, there are no multicolor presses used in Navy print shops.

PERFECTING PRESSES

Presses that are equipped to print on both sides of the sheet in a single run are known as perfectors. Perfecting presses may be either web or sheet fed and may be single-color or multicolor presses. The operating principle for these presses is shown in the diagram in figure 11-3.

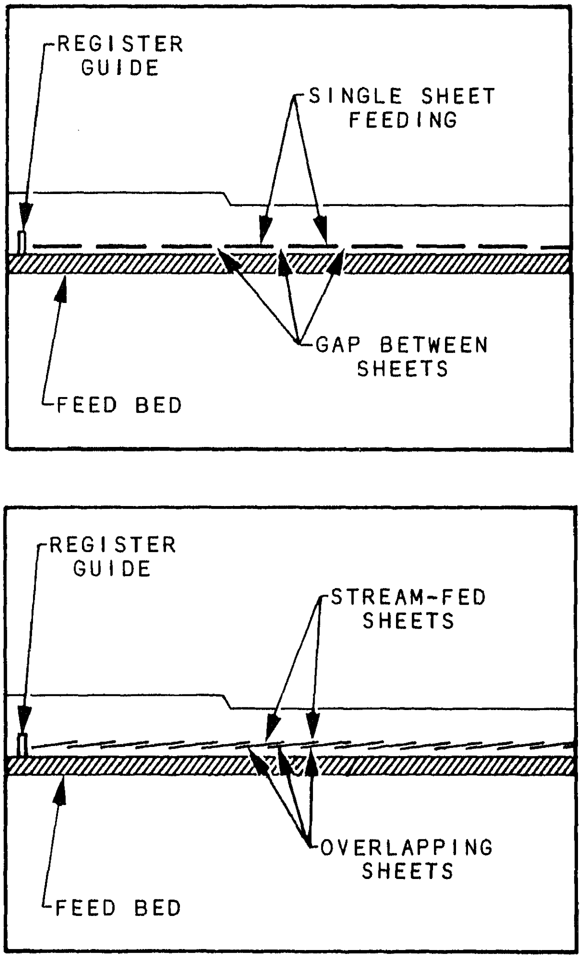


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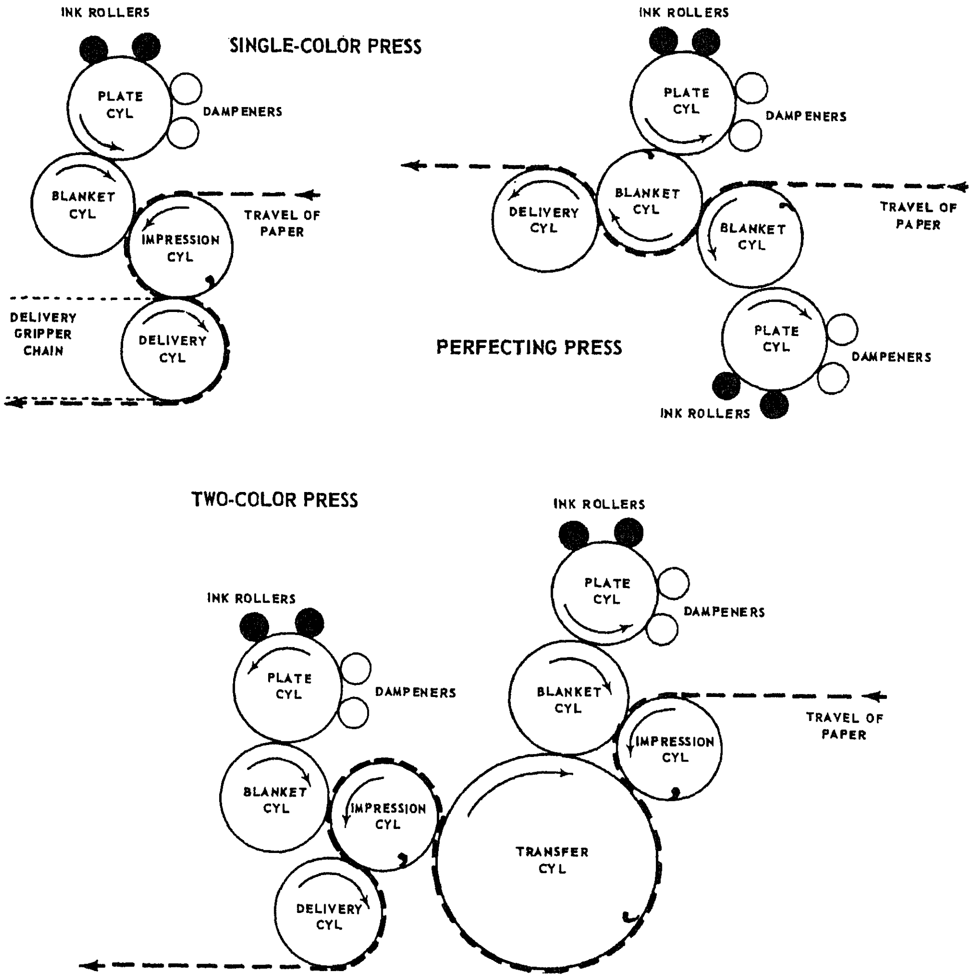
Figure 11-2.—Comparison of single-sheet feeder, above, and



57.216

Figure 11-3.—Single-color, perfecting, and two-color presses.

On single-color presses, impression cylinder grippers close on the sheet at the end of the feedboard and draw it into the printing unit, where it is pressed against the rubber blanket by the impression cylinder to receive the inked image. After receiving the impression, the sheet is released to the delivery grippers, which carry it to the delivery platform. On two-color presses like the one shown in figure 11-3, the impression cylinder grippers release the sheet to grippers on the transfer cylinder as the sheet comes out of the first printing unit. The transfer cylinder grippers, in turn, release the sheet to the grippers on the impression cylinder in the second printing unit. The second color is printed as the sheet passes through this unit, and the sheet is then released to the delivery grippers. The transfer cylinder has twice the diameter and rotates at half the speed of the impression cylinder, giving the ink time to set between the first and second impressions. On perfecting presses like the one shown here, the sheet is drawn into the printing unit by grippers on the lower blanket cylinder. It is then transferred to grippers on the upper blanket cylinder. The printing pressure goes on automatically to bring the two blanket cylinders together. And both sides of the sheet are printed simultaneously before the paper is released to the delivery unit. The cylinder arrangement on multicolor and perfecting presses varies from one type of press to another. On some two-color presses, for example, there is no transfer cylinder. A single impression cylinder serves both printing units, and both colors are printed as the sheet is drawn around this cylinder.

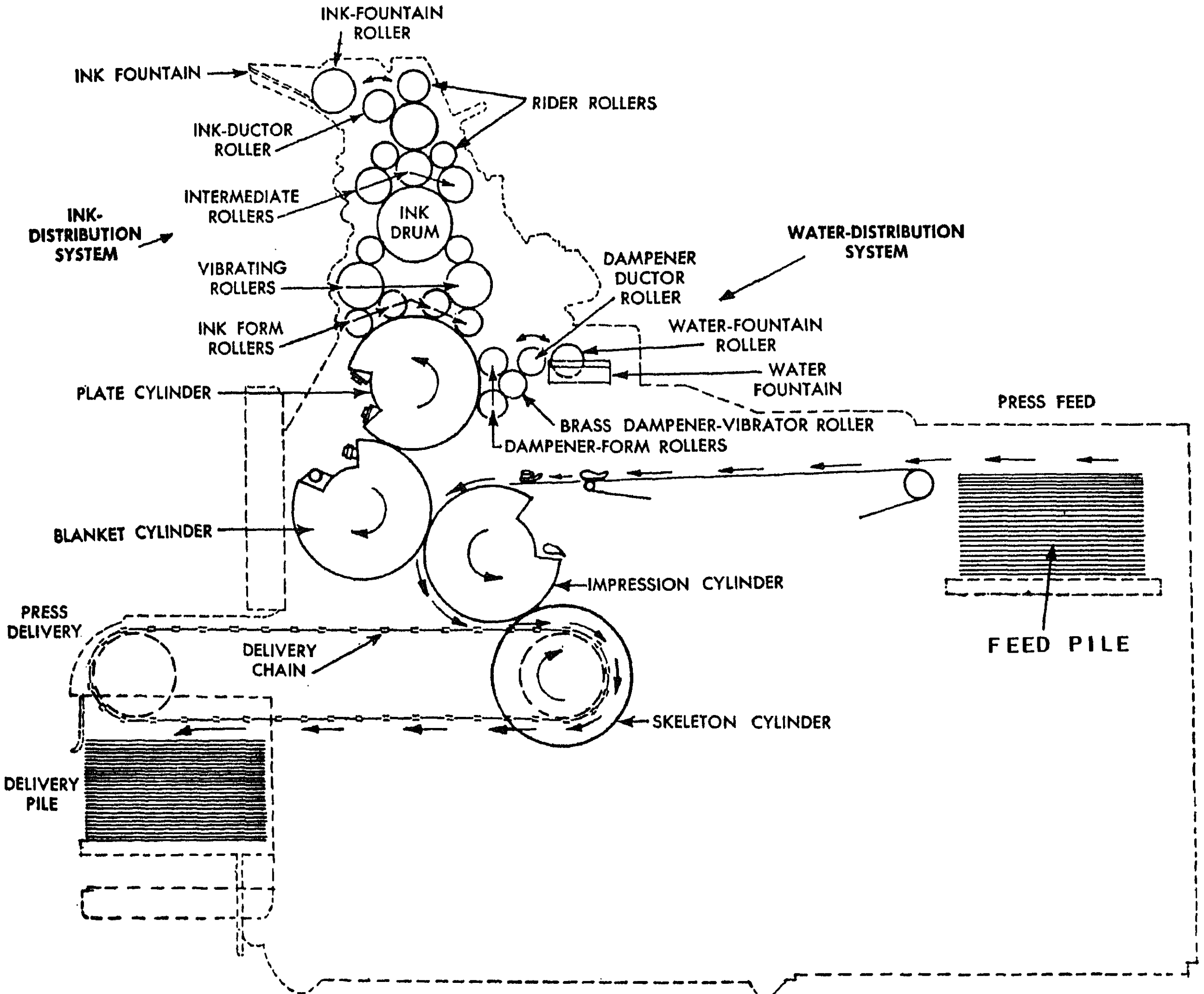
NAVY PRESSES

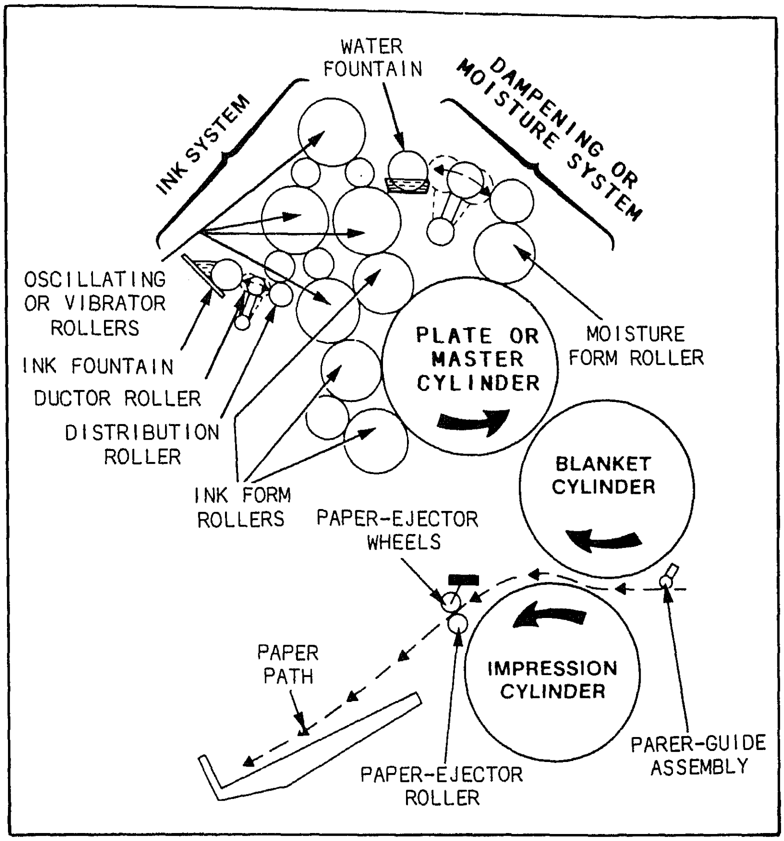
Some of the presses mentioned in this chapter are used for specialty or publication printing and are not found in the average shop. The detailed discussion in this manual will be limited to single-color, sheet-fed (pile feeder) presses of the type which you are most likely to be using in your work as a Navy Lithographer.

THE OFFSET PRESS OPERATION

Look at the diagram of the printing unit of the single-color press shown in figure 11-4. Notice that the printing unit of the press consists of an ink fountain and rollers and three metal cylinders. The plate (or master) is attached to the top (or plate) cylinder; a rubber blanket is attached to the second (or blanket) cylinder. The third (or impression) cylinder carries the paper through the press, forcing it against the rubber blanket to make the printed impression. (As you can also see, there is a fourth cylinder. That cylinder is known as the skeleton cylinder. The skeleton cylinder is not discussed until later in this chapter, because it is considered to be a part of the delivery unit of the press.)

When the press is in operation, the cylinders revolve, and the plate on the plate cylinder is carried first under (against) the dampening rollers, then under (against) the inking rollers, and finally against the rubber blanket. The dampening rollers moisten the non-image areas of the plate, but do not affect the greasy ink image. The ink rollers





57.769

Figure 11-5.—The inking system on a small offset press. Most presses use a combination of metal and rubber (or plastic) rollers. Some of the ink rollers are larger in circumference than the others, so that they will not contact each other in the same place each time they rotate. The form rollers may be equal in circumference, or they may be varied in size to provide better ink distribution to the plate.

then ink only the image areas, because the ink will not stick to a moistened surface in the non-image area.

After the plate passes under (against) the ink rollers, it contacts the blanket cylinder, transferring the inked image to the blanket. The blanket, in turn, offsets (or prints) the ink image onto the paper, which is forced against it by the impression cylinder. The image reads left-to-right on the plate, backwards on the blanket, and left-to-right again on the paper.

The printing unit is only a part of the offset press. As you can see in figure 11-4, the press is also equipped with an automatic feeder and a delivery unit. The feeder is built to deliver the sheets one at a time down the feedboard to the printing unit. At the end of the feedboard, a set of metal gripper fingers (contained in a recess in the impression cylinder) close on the edge of the paper and draw it between the cylinders. As the sheet comes out of the printing unit, the cylinder grippers open and release it to a set of delivery grippers that carry it to the end of the press and release it onto the delivery pile of printed sheets.

Study figure 11-4. Trace the path the paper takes as it travels from the feed pile, between the blanket and impression cylinders, to the delivery pile. As soon as you have the overall picture of the press fixed in your mind, you can proceed with a closer study of its operating units.

INKING SYSTEM

The inking system is composed of an ink fountain and a set of metal and rubber or composition rollers. The number of rollers varies with the size of the press. If the press is large, more rollers are required to work out and distribute the ink.

This fountain consists essentially of a steel blade that is attached to a metal roller in such a way as to form a reservoir or trough for the ink (see fig. 11-5). Each morning you should fill the fountain with ink, and at the end of the day, remove the ink and clean the fountain and fountain rollers.

When you are operating the press, the metal fountain roller revolves in the fountain, picking up a thin film of ink which it yields to the ductor roller (see fig. 11-5). The ductor roller swings back and forth, alternately contacting the fountain roller and a distribution roller. Since the distribution roller is in continuous contact with other rollers, it receives the ink from the ductor roller and transfers it to the other rollers. The distributing and idler rollers (the smaller rollers of the inking system) break down the ink before it reaches the oscillating (vibrator) rollers. The vibrator rollers move back and forth sidewise as they rotate, spreading the ink evenly over the form rollers. The form rollers then contact the image on the plate and ink it.

Raising and Lowering the Form Rollers

Small presses generally have two form rollers. Larger presses usually have more. A handle or lever is provided for lowering the rollers to contact the plate or for lifting them out of contact with it. The press operator must raise or lower the rollers manually when operating the smaller nonautomated presses.

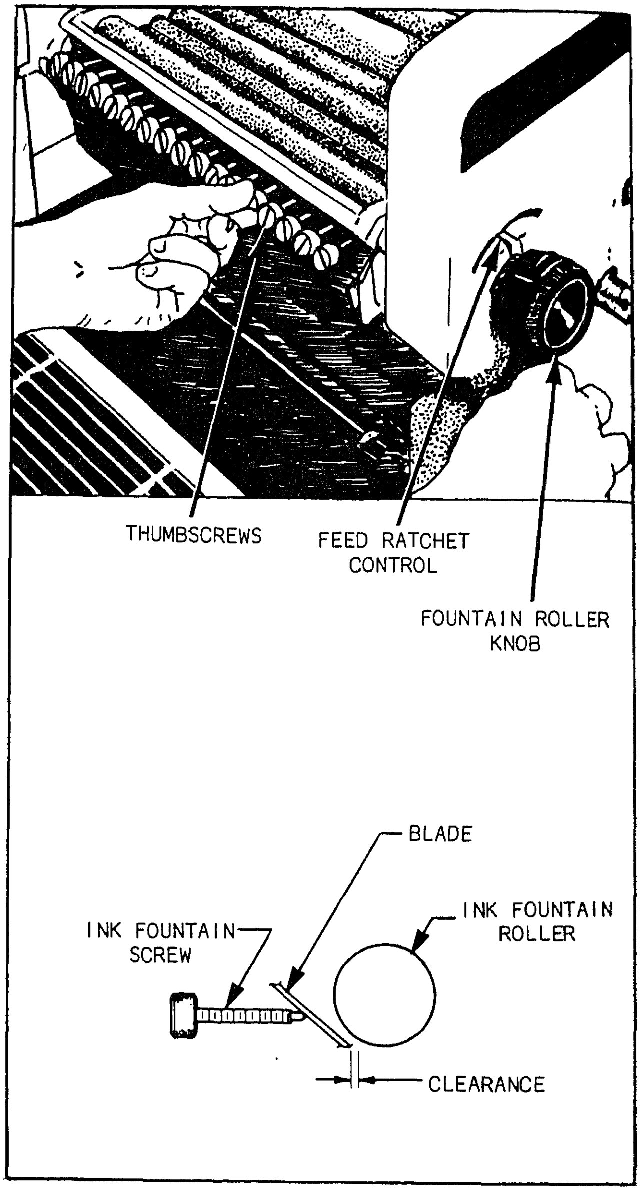
On the larger presses, the form rollers function automatically. They drop against the plate when the press operator moves (throws on) the impression (pushes a lever to bring the cylinders together so that the press will print), and the form rollers rise again when the impression is thrown off. However, you must still raise and lower the form rollers by hand when you are mounting a plate or making roller adjustments or removing a plate from the press.

Fountain Keys

The supply of ink to the ink roller system is regulated at the fountain by a series of thumbscrews (keys) like those shown in figure 11-6.

By adjusting these keys, you can move the blade of the ink fountain system closer to or away from the fountain roller. The farther away the blade is moved, the thicker will be the film of ink carried on the roller, and the greater will be the amount of ink fed to the plate.

The adjustment of these keys enables the press operator to control not only the amount of ink but also its distribution. See figure 11-6. The operator can set them to distribute the ink evenly over the rollers or to make the ink run heavier (or lighter) in one area than in another.



57.770

Figure 11-6.—Feeding an even film of ink across the full width of the fountain roller.

Ink Feed Ratchet Control

The supply of ink is further regulated by a ratchet control, which governs the speed (number of revolutions per minute) of the ink fountain roller. The farther the ink fountain roller travels while it is in contact with the ductor roller, the greater will be the amount of ink transferred to the ductor roller.

Most press operators operate with a minimum of ink on the fountain roller, regulating the throw (speed) of the roller, as necessary, to control the amount of ink supplied to the plate.

By moving this control, you can stop the fountain roller from turning and thus completely shut off the ink supply. You can also turn the fountain roller by hand (with a knob, crank, or lever) if it is necessary to increase the ink feed momentarily during a run.

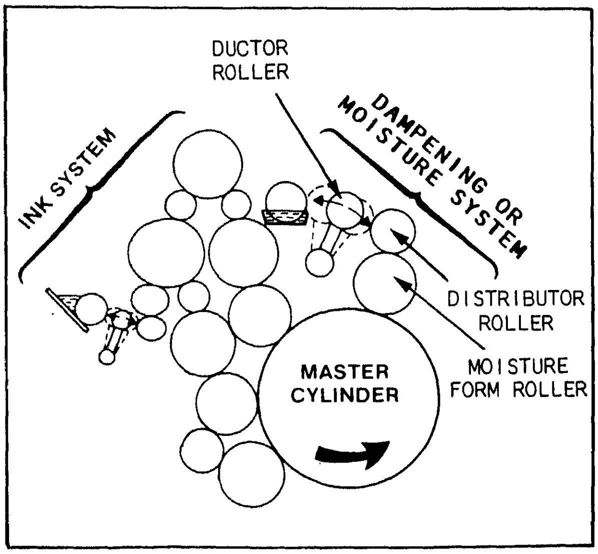
Ink Roller Covers

The ink rollers are not normally covered. However, press operators sometimes cover them with a transparent sleeve made of a fluorocarbon resinous material. These covers make the rollers easier to clean and provide certain inking advantages, such as ink coverage and distribution.

DAMPENING SYSTEM

The dampening system is similar to the inking system except that the ductor and form rollers (fig. 11-7) are generally covered with a close-woven cloth, known as molleton. (This text refers to all dampener covers as molleton covers; however, there are other types of fabric covers that press operators use instead of molleton covers.)

The fountain roller revolves in a pan that contains water mixed with a chemical solution known as fountain etch. It transfers a thin film of this water (fountain solution) to the ductor roller. The ductor roller, in turn, yields the water to a distributor roller, which passes it on to the form rollers. See figure 11-7. Some of the smaller presses have only one form roller, but most presses have two.



57.771

Figure 11-7.—The dampening (or moisture) system on an offset press.

These rollers do not, as a rule, make or break contact with the plate automatically. The operator must move them to or away from the plate with a handle or crank.

Water Feed Ratchet Control

The water fountain is simply a metal pan or reservoir holding the fountain solution (water). It has no blade or keys for controlling the distribution and flow of the water. The water supply is controlled by a ratchet adjustment, which governs the number of revolutions per minute of the fountain roller, or by an adjusting screw or cam, which governs the length of time that the ductor roller is in contact with the fountain roller.

Water Stops

Some press operators attach water stops (small strips of metal with rubber blades) to the fountain. The rubber blades ride against the water fountain roller and squeegee off some of the water, thus reducing the supply reaching the dampeners in local areas. Water stops are standard equipment on larger presses.

On some presses, the operator can shut off the water supply by pulling a lever that stops the fountain roller from turning on the fountain or by moving a lever that will break contact between the ductor roller and fountain roller.

Fountain Solutions

The fountain solution mixtures require careful control. If the chemicals in the water are too strong, the image will disintegrate, or "walk off" the plate, during the press run. On the other hand, if the chemicals are too weak, the non-image areas of the plate may become receptive to ink, and "scum" will develop.

A prepared fountain solution (etch) is supplied by the manufacturers of the smaller presses, and the press operator simply mixes a portion of this etch with the correct amount of water, following the directions supplied by the manufacturer. Prepared solutions are also available for the larger presses, but in many cases, the etches for these are mixed in the shop. Formulas for fountain etches for fountain solutions are listed in appendix 2. It is possible to run presensitized, direct image, and similar types of plates with a fountain solution listed for aluminum plates.

At times, it may be necessary to dilute a fountain solution, particularly if the solution tends to break down the image on the plate. Direct-image paper plates sometimes require a stronger fountain solution than presensitized metal plates. However, you may obtain satisfactory images from direct-image paper plates simply by moving the water- and ink-feed controls to a higher setting. Special solutions are often required for running plates made by the camera-direct process. The instructions that come with each package of plates generally recommend the strength of the fountain solution to be used.

When only one type of plate is used in the shop, inking and moistening control is relatively simple. However, if a shop uses a variety of plates, you may find it necessary to make press adjustments when switching from one type of plate to another.

Since cloth-covered water dampener rollers tend to pick up chemicals and other impurities from each type of plate being run, many shops keep two or more sets of these rollers on hand and use each set only when they are running a specific type of plate.

Water and Ink Balance

Good image reproduction requires a proper balance of water and ink to the plate. Too much water will cause the printed image to be gray and dull; and if the chemicals in the water are too strong, they may undermine the image on the plate.

Too much ink or insufficient water, on the other hand, will cause the plate to take ink in the non-image areas. Too much ink may also cause image lines to thicken and halftone areas to fill in.

Roller Covers

You have just seen that the ductor and form rollers in the dampening system are usually covered with a cloth called molleton. The ductor and form rollers can require only one cover each. If a roller requires two coverings, the inner cover usually consists of a layer of flannel, and the outer covering consists of molleton. These coverings pick up ink over a period of time and eventually

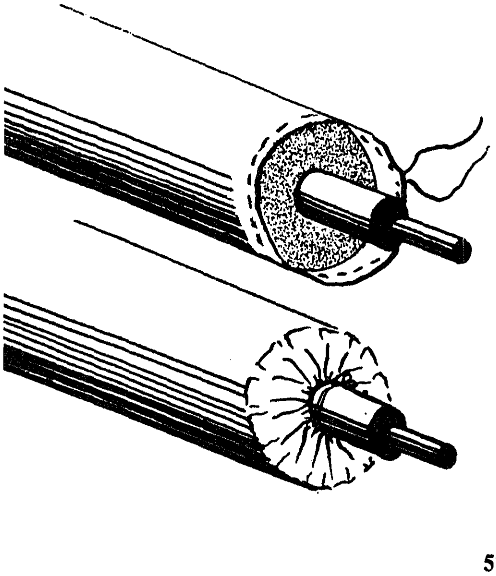
The press operator should change the covering at least every 4 to 5 weeks, depending on its condition.

Covers come manufactured in a variety of ways. Covers for the rollers of large presses may come on a long continuous roll. You must cut your covering at the required length and secure it tightly after placing it on the rollers. You simply slip this seamless roller-cover (tubing) over the roller and sew a drawstring on one end, as shown in figure 11-8. After tying this drawstring, you should wet your hands in order to grip the cloth and stretch it as much as possible. Then sew another drawstring in the other end and tie it.

Covers for the rollers of smaller presses can be machine stitched, open-end sleeves with drawstrings. These covers are available in a variety of lengths and diameters to fit your roller requirements.

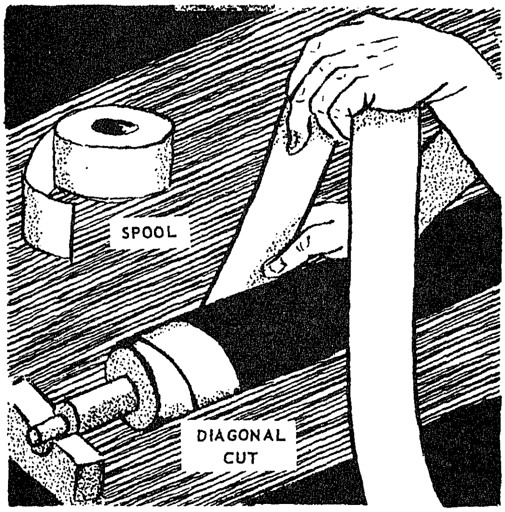
Paper Covers

In some shops, paper coverings are used on the form rollers instead of cloth covers. Paper covers tend to stay cleaner longer, and they also provide more uniform contact with the plate. However, paper covers are not interchangeable with cloth covers. Before paper covers can be used, it is necessary to have the roller cores re-covered with a softer rubber, ground to precision dimensions.



57.222

Figure 11-8.—Method of securing end of cloth cover on dampening roller. The press operator must be familiar



57.223

Figure 11-9.—Wrapping a form roller with a paper covering. This method of wrapping results in a seamless, double-wrapped covering. Paper covers are also available as seamless sleeves.

The parchment used for paper covers comes in long, narrow strips on spools like the one shown in figure 11-9. It is wrapped around the roller in a spiral fashion, with the edges of the strip either butting against each other or overlapping one another on the roller. Cut a strip about 6 1/2 times the length of the roller. Then make a diagonal cut at one end of the strip, in the manner shown in figure 11-10. You should then place the diagonally cut edge parallel with the end of the roller as you start wrapping so that the paper covering will be wrapped around the roller at an angle. You should overlap the first turn and continue wrapping, overlapping each succeeding turn until you reach the other end of the roller. Then slip a rubber band over each end of the roller to keep the wrapping from coming loose when the press is running.

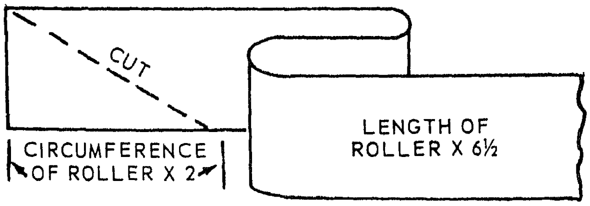


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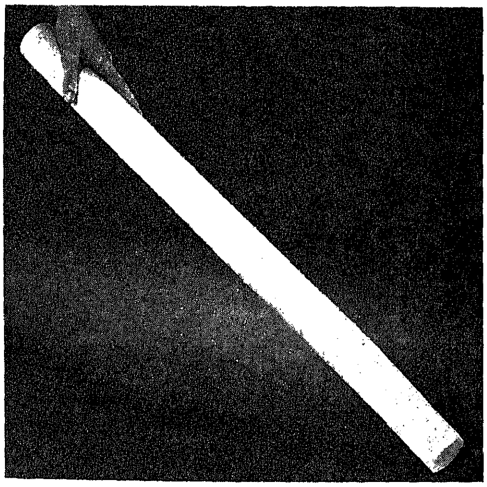
Figure 11-10.—The press operator marks off a distance equal to twice the circumference of the roller and marks the paper dampener strip. Then the press operator draws a diagonal line from this mark to the upper left corner of the strip and cuts along this line. Next the press operator places the cut edge parallel with the end of the roller as shown in figure 11-9, then begins wrapping the dampener roller.



57.740

Figure 11-11.—Sleeve cover.

Slip on (sleeve) covers like the one shown in figure 11-11 are similar to the parchment covers just described except that they come in a sleeve and do not require winding.

If the sleeve gets dirty or if you are switching from a dark to a lighter color of ink, the cover should be cleaned with a commercial cleaner-conditioner or any non-oily press solvent. If it is necessary to change the cover, remove the roller from the press and tear off the dirty sleeve. Then clean the roller with a mild solvent and slip on the new sleeve, allowing it to overhang an equal amount at both ends of the roller. After this, wet the cover under running water; the moisture shrinks the covering and makes it hug the roller. You then replace the roller (in the same position) in the press. No run-in period is required, and it is not necessary to reset the roller tension when changing these roller covers.

Water Roller-to-Ink Roller Dampening Systems

The dampening system of the A. B. Dick Offset Duplicator differs from the conventional dampening system. On the A. B. Dick presses, the water (fountain solution) and ink are both fed to the plate from the same set of form rollers. This system is referred to as a dahlgren system.

When the press is in operation, the ink is distributed over all of the ink rollers and some of the rollers in the dampening system. The fountain solution, in turn, is distributed to the rollers in the dampening system and also to some of the ink rollers. Thus, the form rollers are covered with a film of water as well as with a layer of ink. As the plate contacts these rollers, they give up their moisture to the non-image areas of the plate and transfer the ink to the ink-receptive image areas. The dahlgren system developed for the larger presses is also based on this principle. It can be attached to presses already in use or can be supplied on special order when new presses are purchased.

Although the manufacturers of the presses generally recommend inks and fountain solutions specially formulated for use with their equipment, any good offset ink or fountain solution can be used on these presses without creating problems. Anhydrous grain alcohol is sometimes mixed with the fountain solution. It acts as a wetting agent and increases the effectiveness of the solution. Eight ounces of alcohol is added to each quart of the solution.

NOTE

The use of alcohol in closed spaces is a safety hazard. Use only in well-ventilated areas and store only in authorized spaces.

PRESS CYLINDERS

On the larger presses, there is a metal band (bearer) at each end of the plate and blanket cylinders. These bearers maintain the correct separation between the press cylinders. The recessed (undercut) section between the bearers allows for the thickness of a plate or blanket which is clamped around the cylinder. See figure 11-12.

As a rule, the thickness of the plate and blanket is less than the combined depths of the undercut sections of the cylinders. Therefore, it is necessary for the press operator to pack or underlay the blanket and plate with sheets of paper (referred to as packing) so that their surfaces will be in contact with one another.

It is not enough for the plate to just contact the blanket. The two must be brought together with a slight pressure so that there will be sufficient "squeeze" for the image to transfer from the plate to the blanket. This means that additional packing sheets must be used so that the plate and blanket will extend slightly above the height of the bearers. The correct pressure depends to some degree on the type of plate and blanket used and on the size of the press. The pressure generally recommended for running presensitized plates on smaller presses is 0.002 of an inch, but larger presses may require a pressure of 0.003 or 0.004 of an inch. Too little pressure may result in a light, fuzzy, broken image, and too much pressure may result in slur and double printing. Too much pressure also causes friction, which shortens the life of the plate during the press operation.

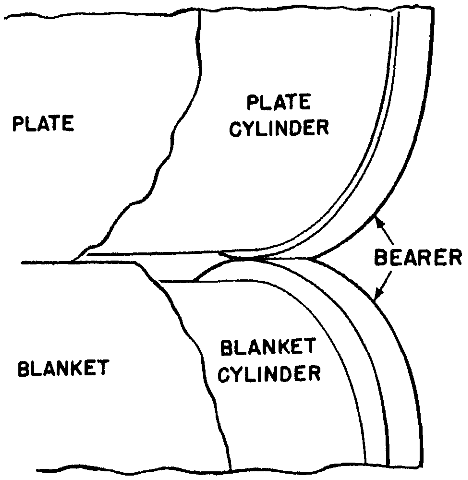


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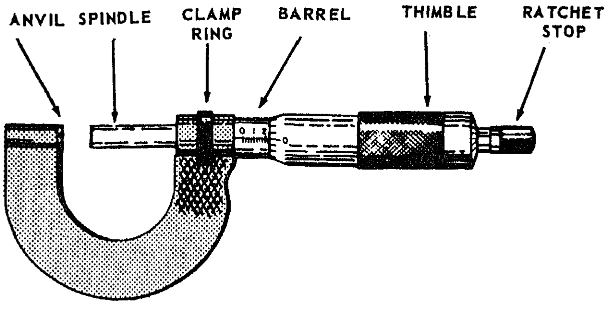
Figure 11-12.—Diagram of the plate and blanket cylinders showing the undercut section for the plate and rubber blanket. The depth of the undercut section is generally stamped on the end of the cylinder or in the cylinder gap. If it is not, the press operator can determine it by measuring it with a packing gage or by placing a straightedge across both cylinder bearers and then measuring the clearance between the body of the cylinder and the straightedge with a feeler gage (a device used for measuring the distance between two surfaces).

Although some press operators prefer to use 0.004-inch printing pressure on the larger presses, most press operators use only 0.003 of an inch. This pressure is usually provided by overpacking the plate 0.001 of an inch above the bearers and overpacking the blanket 0.002 of an inch above the bearers. Some press operators, however, put all the overpacking behind the plate, whereas others put it all under the blanket. As long as the plate and blanket are both packed to bearer height, the overpacking can be added to either



4.20

Figure 11-13.—One type of micrometer. Each line on the barrel represents 0.025 of an inch, and each line on the thimble represents 0.001 of an inch. The press operator turns the thimble until the measuring faces clamp the plate. He then counts the number of lines (not including the zero line) on the barrel and multiplies this number by 25. The result is a reading in thousandths of an inch. To this, the operator adds the number of lines on the thimble. The total is the thickness of the plate.

cylinder or can be divided between them in any proportion. Press operators sometimes manipulate the packing when they are running close-register work if the paper stretches or shrinks between press runs. Shifting packing from the plate to the blanket lengthens the printed image slightly, and transferring packing from the blanket to the plate shortens the image on the paper.

To determine the amount of packing (underpacking) that is required, you actually measure the thickness of the plate or blanket with a precision instrument, known as a micrometer (fig. 11-13). Then deduct this thickness from the depth of the undercut section (which is generally stamped on the end of the cylinder or in the cylinder gap). Then add enough packing to make up the difference between the two amounts and to bring the blanket or plate to the recommended printing height.

When mounting a plate or blanket, press operators generally "mike" the plate and blanket (using the micrometer) at several points, because its thickness may vary from one area to another. Then an average of these readings is used for the calculations to determine the required packing.

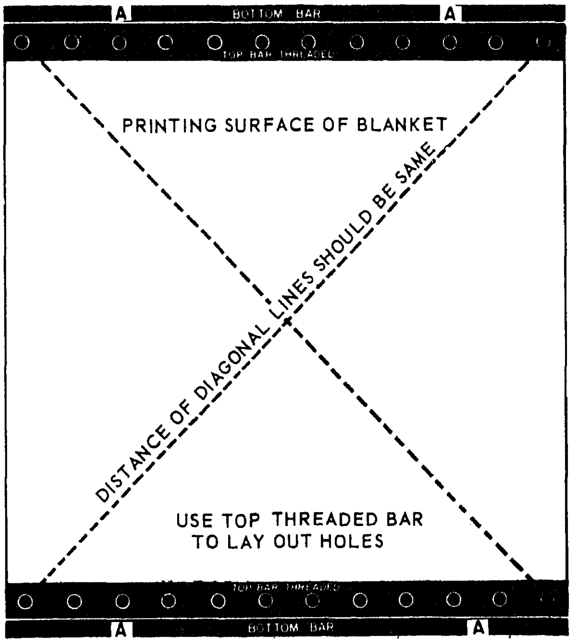
The procedure just discussed does not apply to the small offset presses. Normally, no packing is used under the plate or blanket on these presses, although the blanket is sometimes spotted or underpacked with small bits of paper to bring up low areas if it is damaged or worn. Smaller presses are usually equipped with adjusting screws or bolts that are used to regulate the pressure by moving the plate and blanket cylinders closer together or farther apart.

Attaching the Blanket to the Cylinder

The blankets for the small offset presses are generally looped or slotted at the ends, and you simply hook the loops or slots over pins on the blanket cylinder and draw the blanket taut with a set of blanket-tightening screws.

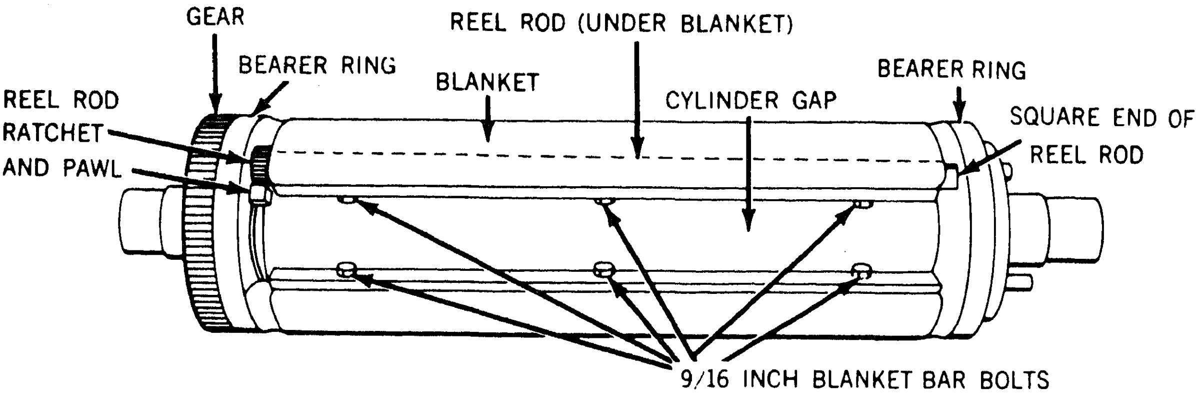
The attaching (mounting) of the blanket on the larger presses is slightly more involved. When working with these presses, you must punch holes along the leading and trailing edges of the blanket and attach clamp bars to these edges before fastening the blanket around the cylinder.

A clamp bar set comes in two parts. Each part has a bar with unthreaded holes, and another bar with threaded holes. You use the threaded bar to find the positions for the holes you must punch in the blanket. To do this, you place the top threaded half over the leading (front) edge of the blanket and place the bottom threaded half over the trailing (back) edge, as shown in figure 11-14.


A
BOTTOM BAR
A
TOP BAR THREADED
PRINTING SURFACE OF BLANKET
DISTANCE OF DIAGONAL LINES SHOULD BE SAME
USE TOP THREADED BAR TO LAY OUT HOLES
TOP BAR THREADED
A
BOTTOM BAR
A

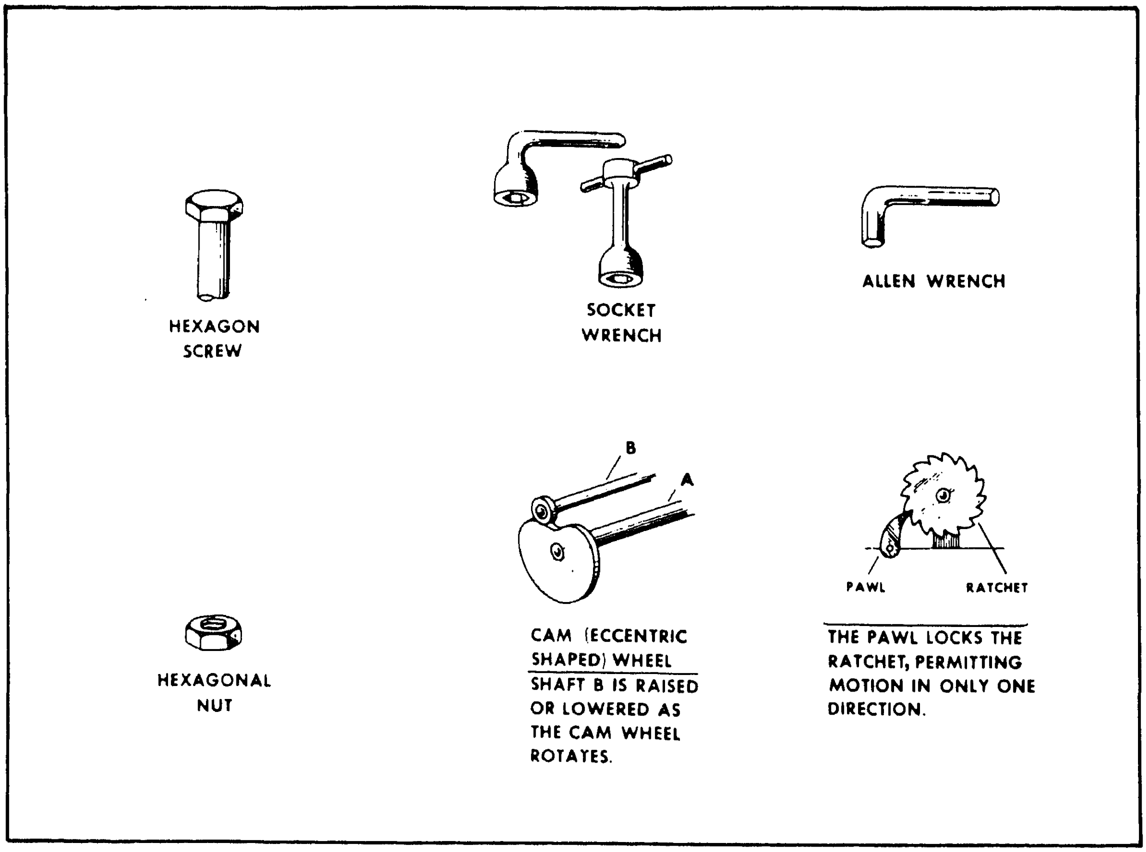
57.227X

Figure 11-14.—Diagram showing how the clamp bars are attached to the blanket. Blanket is square if the diagonal dotted lines are of equal length. Grooves (A) are slipped under locknuts at each edge of the blanket cylinder when the blanket is mounted on the press.



57.228

Figure 11-15.—Diagram of the blanket cylinder. When mounting the blanket, the press operator slips the blanket clamp bars under locknuts at the gripper edge of the cylinder and on the square reel at the tail edge of the cylinder, then turns the reel to draw the blanket taut. The pawl engages the reel ratchet to prevent the reel from slipping.


HEXAGON SCREW
SOCKET WRENCH
ALLEN WRENCH
B
A
PAWL
RATCHET
HEXAGONAL NUT
CAM (ECCENTRIC SHAPED) WHEEL
SHAFT B IS RAISED OR LOWERED AS THE CAM WHEEL ROTATES.
THE PAWL LOCKS THE RATCHET, PERMITTING MOTION IN ONLY ONE DIRECTION.

1.16

Figure 11-16.—Terms you should know.

When you are sure that the bars are parallel and aligned with the edges of the blanket, use a sharp pencil and trace the holes in the bars to indicate where the blanket should be punched.

Before punching the blanket, you should measure the distance from the lower left pencil mark to the upper right mark and also from the lower right mark to the upper left mark. If both of these diagonal dimensions are the same, the blanket is square. You then punch the holes with a leather punch that is slightly larger than the screws to be used to hold the clamp bars in place.

Attaching the Clamp Bars

To attach the clamp bars, you should place the unthreaded half of one of the clamp bars over the leading end of the blanket, and place the threaded half of the bar under the blanket. You then run screws through both parts of the clamp bar and the blanket. Attach both halves of the second clamp bar to the other end of the blanket in the same manner, measuring the diagonals of the blanket again to make sure that the clamp bars are square before tightening the screws.

When the bars are in place, measure the thickness of the blanket with a micrometer to determine the amount of packing you will need to bring it to the recommended printing height above the bearers.

Before mounting the blanket, you should wipe the cylinder surface to make sure that the surface is clean, going over it with a rag moistened with solvent if necessary to remove oil, grease, or other foreign matter. You also check the blanket for damage or defects. Then you turn the press until the recess, or gap, in the blanket cylinder comes into view. See figure 11-15. At this point, insert the clamp bar on one end of the blanket under locknuts at the lower or gripper edge of the cylinder and secure the locknuts. Next, slip the packing in place behind the blanket, allowing it to overlap the edge of the cylinder slightly so that it will not slip when the press is running. You then move the press (by turning a handwheel on the side or by jogging it with a button that moves it an inch or so at a time) to draw the blanket and packing around the cylinder. When you reach the tail end of the cylinder (when the gap comes into locknuts on a bar, called the reel. Then turn the reel with a wrench. As the reel turns, the blanket wraps around it and becomes taut. When the blanket is tight, you can slip a small metal finger (pawl) in one of the teeth in the reel ratchet to keep the reel from slipping. See figure 11-16.

The blanket may stretch after you put it on the press. So, after you have run 200 or 300 impressions, if necessary, stop the press and tighten the blanket some more. However, the blanket should not be drawn excessively taut.

Once the blanket is mounted, it need not be changed again for some time unless it becomes damaged or worn. However, most press operators keep two or three blankets on hand and rotate them occasionally so that each blanket can have a resting period. This prolongs the life of the blankets.

Quick-Change Blanket

The quick-change blanket consists of two pieces or sheets of blanket material vice the standard one-piece blanket.

Each sheet of blanket material has an adhesive backing used to secure that sheet to the blanket cylinder. Only the lead blanket clamp or loops are used when placing a quick-change blanket on a press. No tail clamp bars or loops are required, because of the adhesive backing.

Before mounting the blanket on the press, you must first mount its base layer. You can do this by removing the adhesive backing from the base layer. Align the lead edge of the base layer with the lead edge of the blanket cylinder. Place the material in contact with the blanket cylinder surface and wrap the rest around the cylinder. Next, remove the backing from the top (blanket) layer, and place the holes or loops on the lead blanket clamp. Then, wrap the rest of the blanket around the cylinder. (Be sure not to allow any bubbles or wrinkles to occur.)

Mounting the Plate

The plate is fastened around the plate

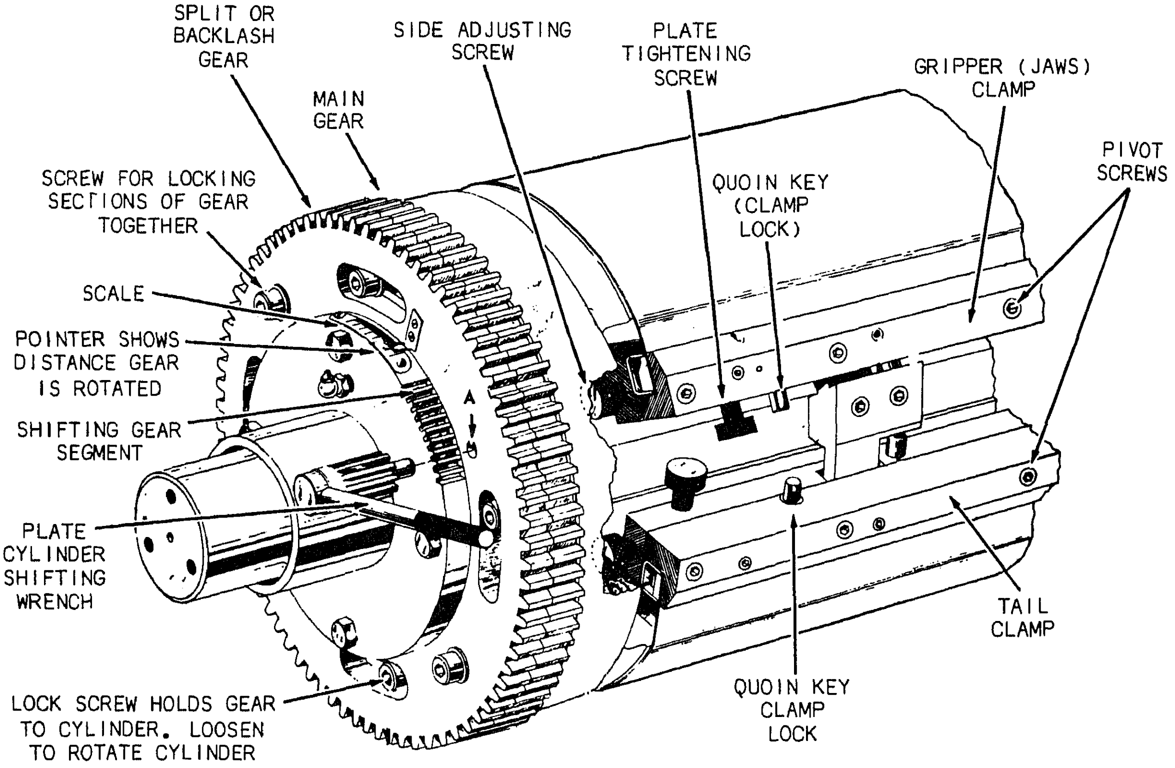


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Figure 11-17.—Plate clamps vary from one type of press to another. However, they all operate on the same principle. All have a means of tightening the jaws of the clamp to grip the plate. This may be an eccentric rod or cam or quoin locks, like those shown here. The clamps are also equipped with plate-tightening screws for stretching the plate taut or twisting it on the cylinder. In the case of cam-locked clamps, it is necessary for the press operator to adjust pivot screws like those shown here to set the clamp for the new thickness (if he changes to a plate of a different thickness) so that the cam will produce the correct grip on the plate. Tail clamps often have some sidewise adjustment for moving the plate sidewise or twisting it on the cylinder. The gripper-edge clamps can also be shifted sidewise on some presses. Most plate cylinders are equipped with locknuts which hold the cylinder to the gear. By loosening these nuts and rotating the cylinder (without moving the gear), the press operator can raise or lower the image on the paper.

in figure 11-17. Before mounting the plate, you, as the press operator, should wipe both the cylinder and the back of the plate to make sure that the surfaces are clean, going over them with a moist rag if necessary to remove dried gum deposits or other foreign matter. You should also check the plate for damage or defects and measure it at four or five points with a micrometer to determine the amount of underpacking it will require.

When this is done, you should rotate the press until the clamps come into view. Loosen these clamps, in turn, with the plate-tightening screws, and slip the top (gripper) edge of the plate into the gripper set of clamps. Then, lock the clamp with a pin wrench or similar device, as shown in figure 11-17.

Next, insert the proper amount of packing behind the plate, allowing the packing to overlap the edge of the cylinder slightly so that it will not slip. Then throw on the impression so that the plate and packing will be held snugly as you rotate the press to wrap them around the cylinder. Of course, the ink rollers would normally drop when the impression goes on, but you lock them up so that they will not ink the dry plate. After doing this, continue rotating the press slowly until the plate and packing are drawn around the cylinder and the cylinder gap appears again.

Now insert the tail edge of the plate in the lower set of clamps and tighten and lock the clamps. Next, turn the plate-tightening screws to draw the plate taut.

The method of mounting the plate varies with the type of press, of course. You have already seen that it is not necessary to underpack the plate on the small offset presses. In some cases, the plates for the smaller offset presses are looped or slotted at the ends, and you simply hook these loops or slots over pins at each edge of the cylinder. Although most of the small presses are equipped with plate-tightening screws, the clamps on these presses normally hold the plate taut with spring tension. The plate-tightening screws are used only to provide additional tension when close-register work is being run or to make adjustments when it is necessary to twist the plate on the cylinder to compensate for a crooked image.

Positioning the Image on the Paper

Sometimes the platemaker or stripper fails to position the image properly. It may be crooked, for example, or it may be too low or too high or slightly off-center on the plate.

If the image is too far out of position, it is necessary to remake the flat and/or the plate. However, if it is only slightly off, you may be able to compensate for image position by making adjustments on the press.

For example, you may be able to center the image on the paper by moving the plate slightly sidewise or by changing the position of the side registering device on the feedboard.

If the image is crooked on the plate, you may be able to compensate for that position by twisting the plate on the cylinder. This is done by loosening the tail edge of the plate so that it will swing freely and then adjusting the plate-tightening screws to move one end of the gripper clamp in farther than the other (set the clamps and plate at an angle). Once the plate is shifted, you should retighten the tail clamp.

If the image prints too low or too high on the paper, you may be able to raise or lower it enough by loosening the lock screws that hold the gear to the cylinder and then rotating the cylinder body. This changes the position of the plate in relation to the impression cylinder grippers and thus shifts the position of the image on the paper. The method of moving the cylinder varies from one press to another. On some presses, you will need to hold the cylinder firm and rotate the press with the handwheel to move the gear; on others, you move the cylinder with a wrench, similar to the method shown in figure 11-17, or with a set of adjusting screws located in the cylinder gap, just inside the bearers.

Reference marks are generally penciled in on the cylinder, and you can match these marks against a gear tooth or some other point on the press to enable you to tell how far the plate moves. A scale is provided for this purposes on some presses.

After you have moved the cylinder the required distance forward or backward, retighten the bolts at the end of the cylinder, wash the blanket, and then run another sheet through the press to check the new location of the image. If further adjustments are necessary, repeat the process just described. (The press operator may also make minute adjustments by adjusting the front guides at the end of the feedboard.)

Impression Cylinder

The impression cylinder is a steel cylinder that forces the sheet against the blanket to transfer the image to the press sheet. It is sometimes called the back cylinder because it is usually located behind the blanket cylinder instead of directly underneath it (see fig. 11-4). Unlike the plate and blanket cylinders, the impression cylinder is not equipped with bearers.

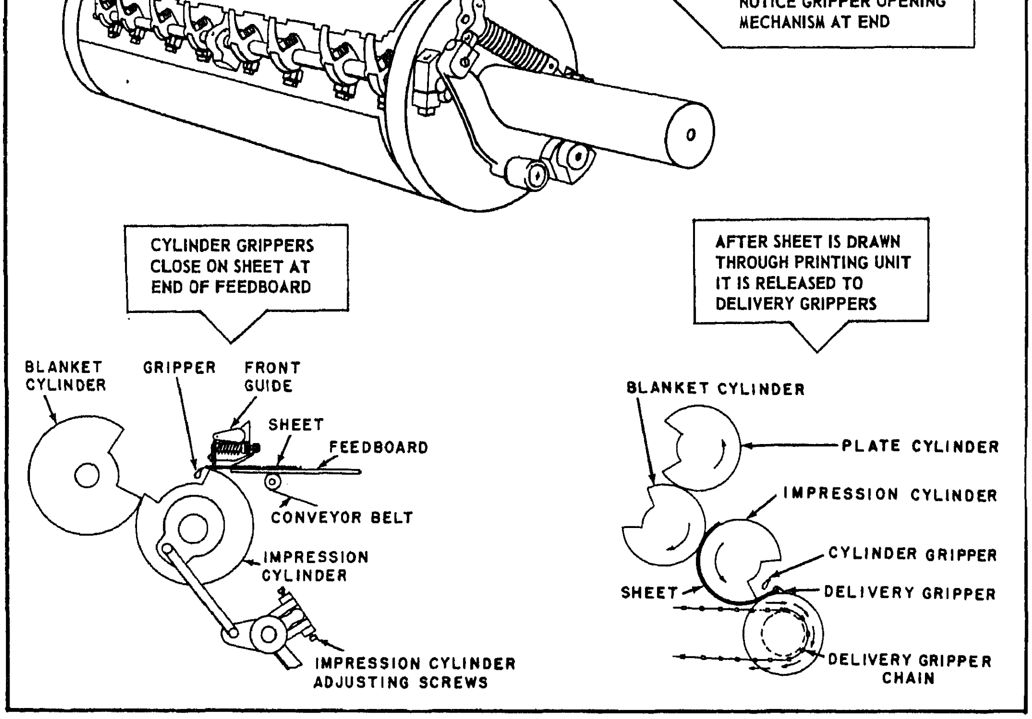
NOTICE GRIPPER OPENING MECHANISM AT END
CYLINDER GRIPPERS CLOSE ON SHEET AT END OF FEEDBOARD
AFTER SHEET IS DRAWN THROUGH PRINTING UNIT IT IS RELEASED TO DELIVERY GRIPPERS
BLANKET CYLINDER
GRIPPER
FRONT GUIDE
SHEET
FEEDBOARD
CONVEYOR BELT
IMPRESSION CYLINDER
IMPRESSION CYLINDER ADJUSTING SCREWS
BLANKET CYLINDER
PLATE CYLINDER
IMPRESSION CYLINDER
CYLINDER GRIPPER
SHEET
DELIVERY GRIPPER
DELIVERY GRIPPER CHAIN

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Figure 11-18.—The impression cylinder.

As you can see in figure 11-18, the gap of this cylinder contains a set of automatic grippers. These grippers grasp the leading edge of the sheet after the sheet reaches the end of the feedboard and draw the sheet around the impression cylinder, which forces it against the blanket to make the impression. Then, at the proper moment, the grippers open to release the sheet to a set of delivery grippers, which carry it on to the delivery stack.

The press operator adjusts the pressure between the blanket and impression cylinder each time he changes from a thick to a thinner paper stock and vice versa. You make this adjustment with adjusting nuts like those shown in figure 11-18 or with a lever or knob that moves the impression cylinder to or away from the blanket.

CONTROL BUTTONS

Most large offset presses are equipped with two separate sets of buttons or switches for controlling the press. One button or switch on the set is used for starting or stopping the press. The other button or switch is used for starting or stopping the vacuum pump, which supplies the air (blast) and suction for separating and picking up the sheets in the feeder stack.

As you can see in figure 11-19, some presses also have buttons for jogging or inching the press (rotating it an inch or so at a time) and another button for reversing the press.

The starting and stopping buttons are generally located on a control panel on the near (operator's) side of the press. Most small presses have only one control panel, but the larger ones may have two or more sets of buttons at different points around the press. These control stations are provided so that you can operate the press from various locations.

Although the press is put in motion when you push the start button, the sheets do not begin feeding through until you turn on the air and (on some presses) push a lever to set the feeder in motion. To stop the press, you should first turn off the feeder and then wait until the last sheet has fed through before pushing the stop button.

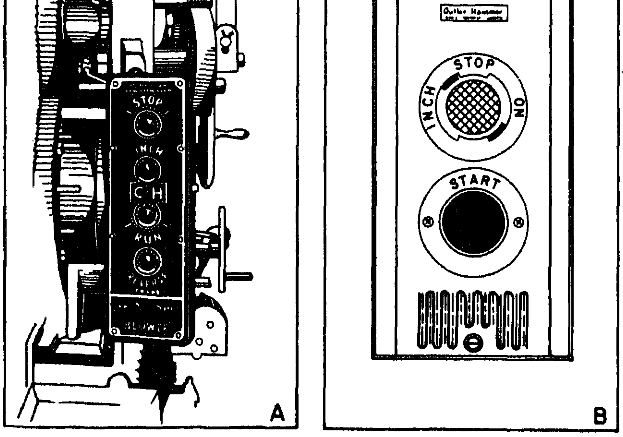

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Figure 11-19.—Starting and stopping buttons found on some of the larger offset presses. Notice starting and stopping buttons for the vacuum pump at the bottom of the control panel on the left.

AUTOMATIC FEEDER

The paper is loaded (stacked) into the feeder on a metal or wooden loading platform. This platform or table rises automatically as the sheets are being fed into the press, keeping the height of the stack constant.

When the feeder is turned on, a vacuum pump provides a stream of air through blower tubes positioned at the front (or back and sides) of the stack. This air floats the top sheets, separating them from the other sheets in the pile.

A set of cam-operated suction feet then dip down against the edge of the top sheet and lift it to the edge of the feedboard. At this point, the suction shuts off and the sucker feet release the sheet to a pair of rubber-rimmed forwarding rollers. These rollers force the paper onto a set of moving conveyor tapes.

The conveyor tapes carry the sheet to the end of the feedboard, where it is stopped by a set of pins known as the front guides. See figure 11-20. Next, a side guide (which moves back and forth as the press operates) pushes (or pulls) the sheet into the proper sidewise position. The action of the side and front guides squares the sheet and ensures register, since this action causes all sheets to enter the printing unit in exactly the same position.

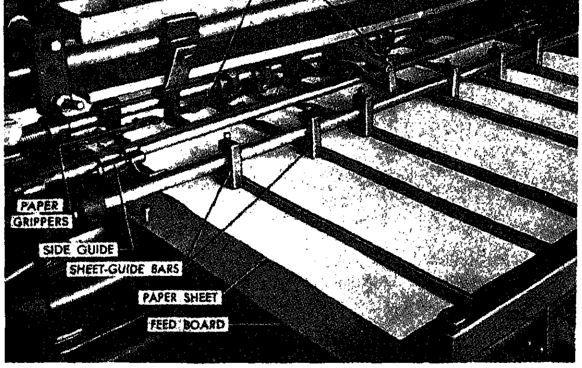

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Figure 11-20.—Paper guides on the feedboard of one of the larger presses.

Just after the sheet reaches the front guides, the grippers located in the gap of the impression cylinder automatically close on the leading (gripper) edge of the sheet. At the same time, the front guides lift (or drop) to release the sheet (see fig. 11-20). The sheet is then drawn around the impression cylinder and forced against the blanket to receive the impression of the image.

On some presses, the impression goes on automatically as soon as the sheets start feeding through and shuts (trips) off automatically whenever a sheet fails to feed. On other presses, the impression does not go on until you move a lever (known as the pressure or impression lever) that lowers (drops) the ink form rollers and brings the blanket and impression cylinders into contact. As a rule, this lever is moved just as the first sheet reaches the front guides. The impression and ink stay on thereafter as long as the sheets continue to feed through, but trip off (break contact) automatically when a sheet misfeeds. You can also raise the form rollers or throw off the impression by hand.

Loading the Feeder

The feed platform (table) rises automatically as the sheets are fed into the press so that the top of the pile stays at a constant height. You can also raise or lower the table by manually turning a crank on the side of the press.

You can lower the feed table when loading the feeder and then raise it again to just below operating height before starting the press. The feed table will rise (work up) automatically, but it is quicker to raise it most of the way manually.

The paper is generally loaded onto the feed platform (table) a fraction of an inch off center toward the side guide. This off-center position allows for the action of the guide, which pushes each sheet into the required position (sidewise) as the paper registers on the feedboard.

Once the feed table is lowered, you can move two metal bars, known as piling bars, to positions along a scale located at the feeder end of the feed table. This positioning will correspond to the width of the stock to be run. When set in position, the bars will be at the leading corners of the paper stack. They will steady the paper as it is fed into the forwarding rollers and also serve as a guide while you are loading the stock.

If the feed table is not equipped with a scale for positioning the piling bars, then you should crease a piece of the stock to be run to find its center at the leading edge and place it on the feed table in a slightly off-center position. Then position the piling bars by moving them up to the edges of the sheet. (The feed table may be marked to show its center, but if it is not, you must approximate the location of the sheet.)

Once the piling bars are set, you can load the stock onto the feed table. The stock is generally loaded in small stacks, called lifts, each about 1 1/2 or 2 inches in height. You should "jog" each lift, fanning or ruffling the stock to introduce a blanket of air between the sheets before loading it onto the feed table (fig. 11-21).

The amount of paper that you load onto the feed table depends on the amount needed and/or the type of press. Most presses will take a stack around 20 inches high. If the press will not take enough paper for a complete run, you must reload the feeder when the first stack has been run.

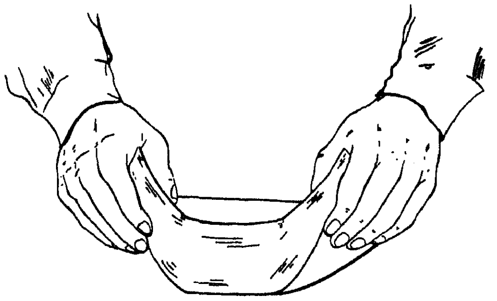

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Figure 11-21.—Fanning a lift of paper to introduce a blanket of air between the sheets.

The feeder setup will vary from one press make and model to another. You should consult the operator's manual of your offset press for specific instructions.

Once you have loaded the feed table and raised it until the top of the stack is about one-fourth of an inch below the sucker feet when they are at their lowest position, you can then position short metal support fingers against the back of the pile. This support will steady the sheets as they are floated by the blast (air from the vacuum pump of the press) and prevent them from jumping as they are picked up by the sucker feet.

Pile Height Governor

The pile height governor, shown in figure 11-22, controls the amount of elevation of the feed table, and you can adjust it to make the stack run higher or lower. As the paper is fed into the press and paper is used, the governor rides lower and lower until it finally allows a pawl to engage, and an elevating ratchet turns, which moves the feed table up. This elevating mechanism varies in its operation from one type of press to another, but the principle is the same on all presses.

Separator Fingers

Most large offset presses are equipped with a set of sheet separators (separator fingers) similar to the ones shown in figure 11-22. These separators are simply steel wires or tongues which hook over the stack and hold down the edge of the top sheet as it is floated by the blast. When the suckers pull the top sheet from the grip of the separator fingers, the fingers drop against the next sheet in the stack to prevent it from being picked up too.

The separator fingers are located at the front (gripper edge) of the paper stack on some presses, as shown in figure 11-22. On others, they are found at the back (trailing edge) or sides of the pile (fig. 11-23).

If the separator fingers drag too heavily against the paper, they may interfere with the action of the sucker feet; if the tension is too light, they may fail to separate the sheets properly. You can adjust them, as necessary, for their required contact with the paper stock.

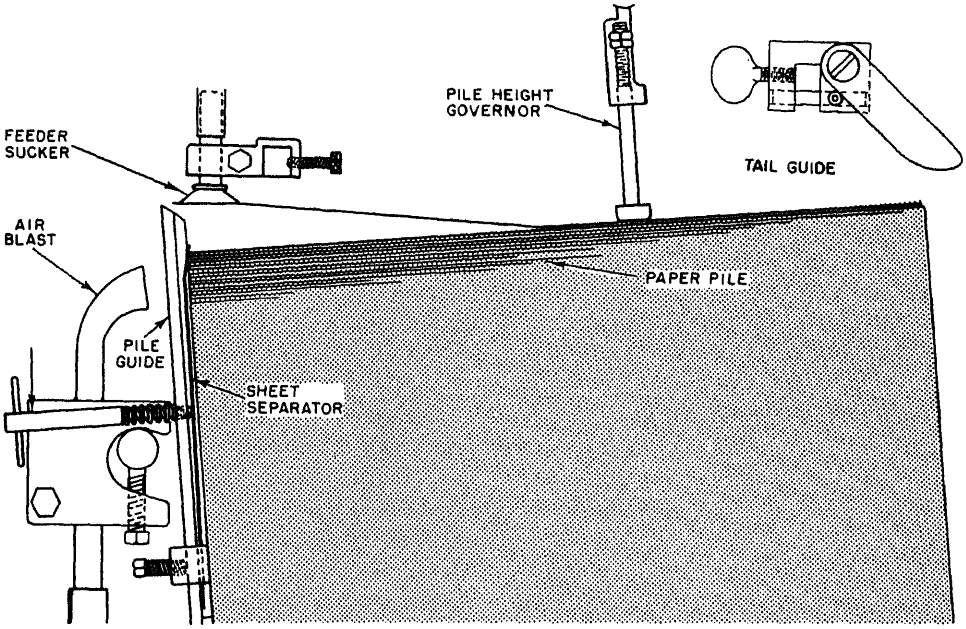

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Figure 11-22.—Sheet feeding controls. Methods of picking up the top sheet and forwarding it to the feedboard vary from one type of press to another. On the press diagrammed here, the top sheet is floated by air from the blast pipes at the front of the pile. The sucker feet then dip down and catch the top sheet and lift it to the edge of the feedboard. Other presses are equipped with separating units like that shown in figure 11-23.

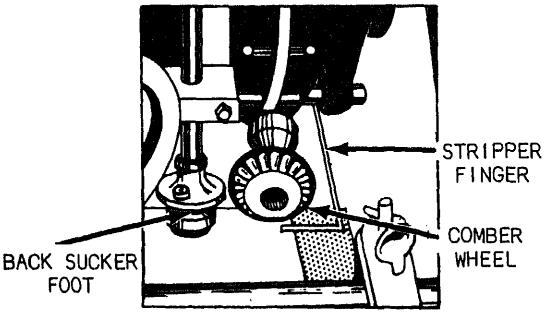

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Figure 11-23.—Separating unit used at back corners of the pile on some presses. When the feeder is in operation, the comber wheels buckle the back corners of the top sheet just enough to permit the back sucker feet to contact it. The back suckers lift the back edge of the paper and two blast feet then swing in between the lifted edge and the pile and supply a cushion of air that floats the top sheet, separating it for its entire length from the other sheets in the stack. At the front of the pile, forwarding sucker feet then catch the sheet and move it up to the edge of the feedboard.

Suction and Blast Adjustments

Incorrect adjustment of suction and blast may cause feeding difficulties. For example, if there is insufficient suction, the sucker feet may fail to pick up the sheet; if there is too much, they may pick up two or more sheets at a time, particularly if the stock is thin. You can regulate the amount of suction and blast with adjusting screws located at the vacuum pump or on the air lines at the side of the press. The blast is ordinarily set to float only the top two or three sheets in the pile.

Press operators often slip bell-shaped rubber tips over the regular metal sucker feet to increase their pulling power when they are running heavy or bulky paper stocks.

Flap Shaft

Some presses are equipped with a shaft and two metal plates at the end of the feed table. When the press is running, the shaft turns to move the plates (called flaps) to or away from the stack. As the flaps move against the stack, they jog the front of the pile to keep the sheets even, and as they move toward the delivery end of the press,

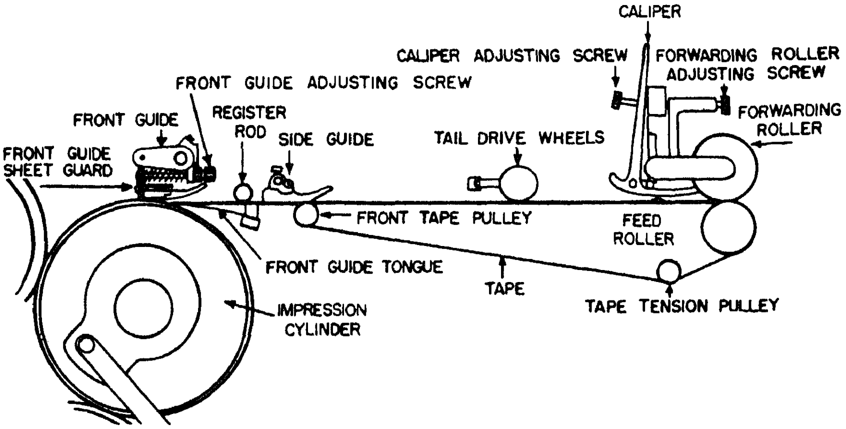

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Figure 11-24.—Feedboard controls.

they tilt forward to form a ramp, which guides the sheet onto the feedboard.

Forwarding Rollers

The sucker feet carry the sheet to the edge of the feedboard and release it to a pair of rubber-rimmed forwarding rollers (see fig. 11-24). These rollers are usually set over the conveyor tapes on large presses. They can be raised or lowered manually, or they will rise and then lower against a bottom roller which rotates as the press runs. This action forces the paper onto the feedboard.

If the pressure is not equal on both of the rubber-rimmed forwarding rollers, the sheets will feed crooked, and you must adjust the tension on one of the rollers. You should raise them by hand to keep the rubber rims from developing flats when the press is not in use.

Caliper

Since double sheets may jam the press or damage the blanket, presses are equipped with a safety device known as the multiple-sheet detector or caliper (see fig. 11-24). (It may also be called the two-sheet choke.) The caliper is generally centered on a bar extending across the feedboard just past the forwarding rollers. By turning an adjusting screw, you can set this device to clear one sheet but to bind when two sheets feed through.

When the caliper on the smaller presses (duplicators) detects two or more sheets of paper, it actuates a mechanism that automatically throws the two sheets into a metal pan below the feedboard. On the larger presses, the caliper trips off the press or holds the sheets until you can remove them by hand.

Conveyor Tapes

As you can see in figure 11-24, the conveyor tapes are endless fabric belts which are threaded over a roller at each end of the feedboard. When the press is in operation, the rollers turn, and the tapes travel down the feedboard and then back under it in one continuous motion. Individual pulleys (under the feedboard) keep the tapes taut.

Sheet Control

Besides the forwarding rollers, which force the sheet onto the moving conveyor tapes, certain controls are required to prevent the sheets from curling or running wild as they are carried down the feedboard. Most presses use metal bars or rods for this purpose. These metal strips, which extend the full length of the feedboard, are generally placed over the conveyor tapes. There must be a slight clearance between the strips and tapes, of course, as a dragging action will cause wear on the tapes and interfere with the movement of the paper.

On most presses, hold-down controls are adjustable sidewise and can be set to accommodate any width of stock. You may also be able to raise them as a unit when removing wrinkled sheets from the caliper or feedboard.

In addition to using these hold-down controls, you can also use detachable wheels and brushes to help control the sheet (see fig. 11-24). The wheels are generally attached to one of the hold-down strips, and they are positioned over the conveyor tapes so they will rest just off the tail end of the paper when the sheet reaches the front guides. In this position they will keep the sheet from bouncing away from the guides, yet will not interfere with the movement of the sheet by the side guide.

Brushes can also be attached to the hold-down rods of the feedboard to help control the sheet. They are set half on and half off the tail edge of the sheet to prevent the paper from bouncing away as it strikes the front guides.

Front Guides

The front guides vary with the make of the press. But in general, they consist of two or more metal posts or pins which stop the sheet, holding it temporarily on the feedboard while the side guide moves the sheet into position (register) sidewise (see fig. 11-24).

As soon as this has been accomplished, the front guides either rise above or drop below the surface of the feedboard to clear the sheet as it is caught by the impression cylinder grippers and pulled into the printing unit. For adjustments of the front guides, refer to your operator's manual for the required procedures.

If your press is so equipped, you can move the front guides sidewise to accommodate different widths of stock, and you can adjust them (forward and backward) to regulate the gripper bite on the paper. (When you move the front guide [stop] toward the cylinder, the stock travels farther into the grippers, and the image prints lower on the paper. When you move the stop in the other direction, the grippers have less bite on the stock, and there is less margin or white space at the top of the sheet.) If the image is slightly crooked on the plate, you may be able to compensate for it by setting one of the guides ahead of the other so that the paper will feed slightly crooked.

Some presses do not have front guides like those discussed here. However, they are equipped with registering devices that serve the same purpose as the front guides.

Insertion Devices

On some presses, the sheet is delivered to the end of the feedboard—within reach of the impression cylinder grippers. On other presses, a special insertion device is required to move the sheet into the cylinder grippers after it reaches the front guides. For example, the Multilith 1330 is equipped with a roller that drops on the sheet (just as the front guides recede) and forces it into the grippers. Larger presses often are equipped with a feed or transfer cylinder at the end of the feedboard. Although it is called a cylinder, it actually consists of a series of disks attached to a shaft and provided with grippers for receiving the paper. These grippers grasp the edge of the sheet at the end of the feedboard and transfer it to the impression cylinder grippers as shown in figure 11-25.

The swing gripper, shown in figure 11-26, is another insertion device that is found on some types of presses.

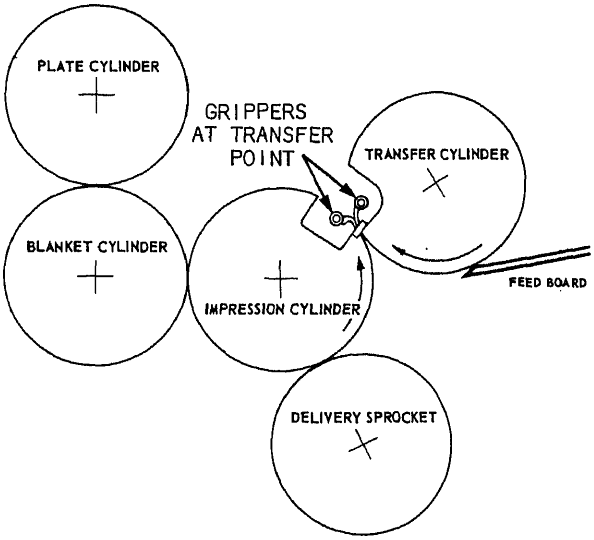

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Figure 11-25.—Diagram showing how the transfer cylinder catches the sheet at the end of the feedboard and transfers it to the impression cylinder grippers.

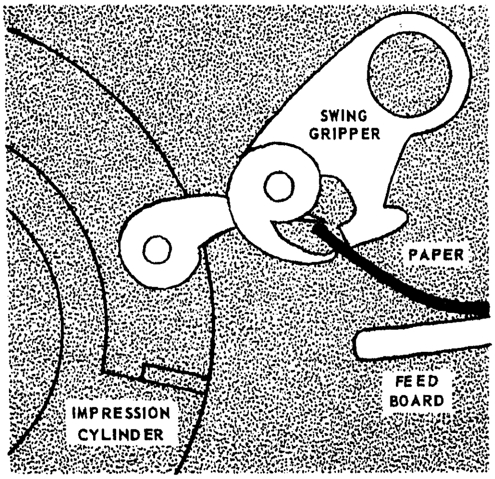

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Figure 11-26.—Swing gripper insertion device. The swing grippers pick up the sheet at the front guides and accelerate it to cylinder speed before transferring it to the impression cylinder grippers.

Side Guides

The side guide is generally attached to a cam-operated bar, which moves back and forth sidewise when the press is running. As the paper reaches the end of the feedboard, the side guide moves the sheet sidewise into its registering position. The smaller (duplicator) presses generally have only one jogging side guide, but the larger presses have two—one on each side of the feedboard. Only one of these guides on a large press is used at a time. You can use the guide on the near (operator's) side for ordinary work, but may use the other side guide when backing up a job.

The method of setting the side guide to the size of sheet being run varies from one press to another. On some presses, it is simply moved to the proper place along a scale on the feedboard. On others, you rotate (inch) the press to deliver a sheet down the feedboard to the front guides. You then move the sheet one-fourth of an inch sidewise (away from the side guide to be used). After this, turn the press until the guide is at the end of its thrust toward the center of the feedboard and then move the side guide up against the sheet and lock it in place.

Sheet-Flattening Bar

Many of the larger presses are equipped with a metal rod, known as the sheet-flattening bar, that drops against the sheet just after it reaches the front guides and steadies the paper as the side guide moves the sheet into register. Smaller presses are not equipped with a sheet-flattening bar.

Sheet Detector Finger

On some of the larger presses, it is necessary for you to push a lever to bring the cylinders into contact (put the press on impression) so that the image will print on the press sheet. The ink form rollers go on simultaneously with the impression on most of these presses. The impression and ink stay on thereafter unless you raise them by hand or unless a sheet jams or fails to feed through the press.

When a sheet fails to feed, a small metal finger at the end of the feedboard drops into a groove in a cog and jams the cog, activating a mechanism that trips off the impression and ink form rollers. If it were not for this detector finger, the blanket would print its image on the impression cylinder surface. Then, unless you stopped the press and cleaned the cylinder, the next sheets that came through the press would be offset or printed on the back as well as the front.

(The sheet detector mechanism is activated differently on certain types of presses.)

Slowdown Mechanism

If a sheet travels down the feedboard too fast, its leading edge may be damaged when it strikes the front guides, causing poor registration. To prevent this, a slowdown cam is provided on some of the larger presses to slow the conveyor tapes briefly just before the sheet reaches the front guides. Slowdown fingers attached to cam-operated arms are also used for this purpose. As these arms move forward, they rise slightly so that the fingers protrude through grooves in the feedboard. The fingers contact the sheet just

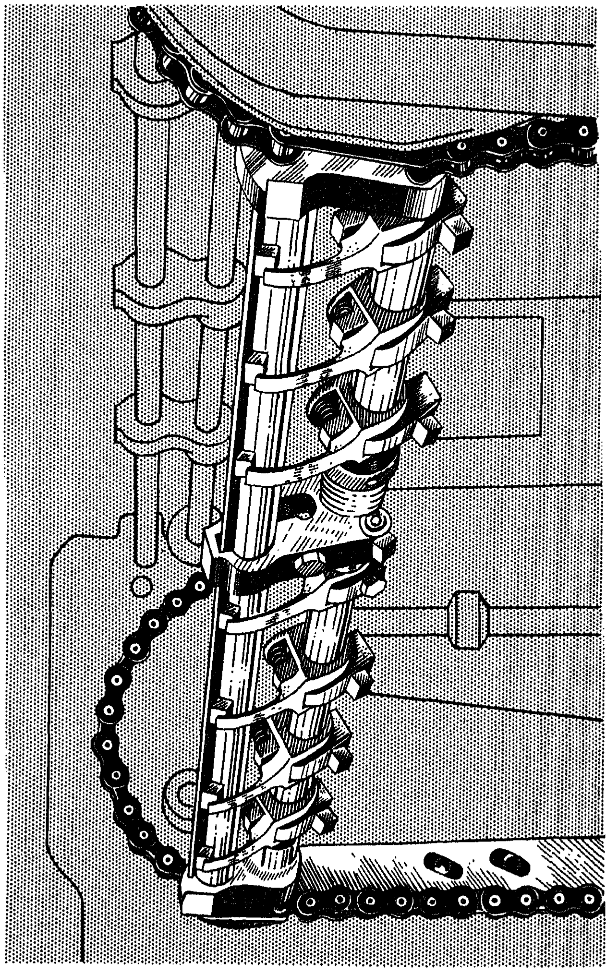

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Figure 11-27.—Delivery grippers.

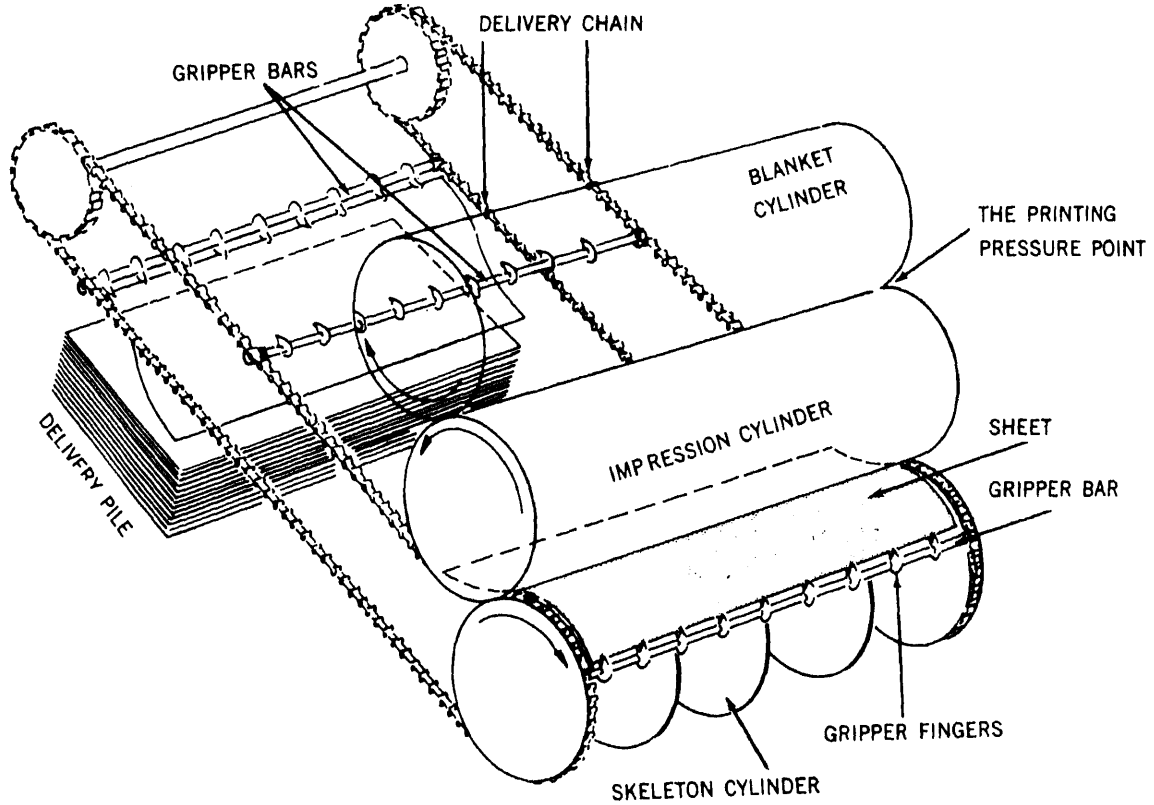

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Figure 11-28.—The delivery (skeleton) cylinder consists essentially of a pair of sprocket wheels, which drive the delivery gripper chains, and a series of evenly-spaced disks or segments, which help control the sheet as it is carried from the printing unit to the delivery platform.

before it reaches the guides and move forward with it. After the sheet reaches the front guides, the arms drop so that the fingers clear the sheet as they swing back to their forward position.

IMPRESSION CYLINDER GRIPPERS

During part of the revolution, the impression cylinder grippers are held (closed) against the edge of the cylinder by spring tension. However, as the cylinder revolves, a pin extending from the press frame engages a tumbler mechanism at the end of the cylinder, causing the tumbler to rotate and turn the shaft to which the grippers are attached. As the shaft turns, the grippers open to receive the sheet. The grippers close again (on the edge of the sheet) as soon as the tumbler passes the pin.

The paper is then drawn into the printing unit (between the blanket and impression cylinders). As the press sheet emerges from between these two cylinders, another pin causes the impression cylinder grippers to open again to release the sheet. As the impression grippers release the sheet, it is caught by a set of delivery grippers, like those shown in figure 11-27, and carried down and around a series of evenly-spaced disks (called the skeleton, or delivery, cylinder) and out over the delivery platform (see fig. 11-28).

(The tumbling device just described is generally found on presses that deliver the sheets within reach of the grippers, but presses that employ special insertion devices at the end of the feedboard often have cam-operated grippers.)

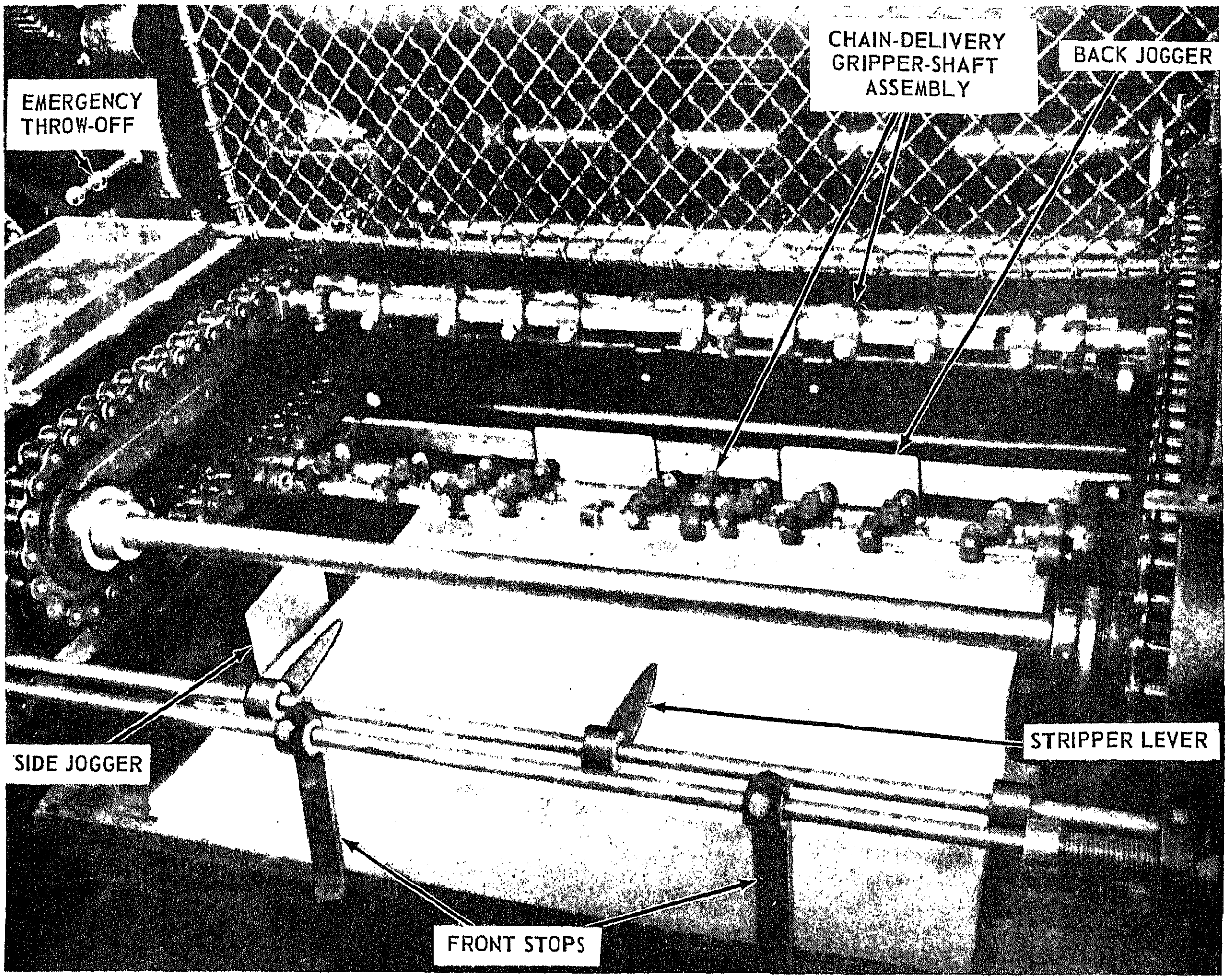

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Figure 11-29.—The delivery platform is set to lower automatically as the printed sheets are delivered. Detachable dollies are used in place of the platform on many presses. As sheets are delivered, the dolly gradually lowers until it reaches the floor. It is then wheeled away and another dolly is inserted in its place.

DELIVERY UNIT

In figure 11-29, the delivery grippers consist of a series of small metal fingers attached to a bar that is extended between two continuous chains. There may be two or more sets of these grippers, depending on the speed of the press and the distance between the delivery platform and the impression cylinder. They are spaced at regular intervals along the chains so that one set of grippers is receiving a sheet while another set is delivering the preceding one.

The grippers are ordinarily held closed by spring pressure, but as the chains carry them toward the impression cylinder, they pass over a trip cam which forces them to open long enough to grasp the edge of the sheet. They then carry the sheet around the skeleton cylinder and out to the end of the press, where another trip cam forces them to open again to release the press sheet onto the delivery platform. Stripper levers (or fingers) like those shown in figure 11-29 are provided to strip the press sheet from the grasp of the delivery grippers and direct it down to the delivery stack. The front stops, shown in the same illustration, prevent the sheet from flying off the platform when it is released.

Delivery Platform

On most of the larger presses the delivery platform is built to lower (recede) either manually or automatically as the press sheets are delivered, and you can set it to recede at your required speed. Some of the smaller presses are not equipped with an automatic receding platform, and you must remove the sheets from the paper receiver at regular intervals to keep the stack from getting too high.

Automatic Joggers

Large presses have automatic side and back joggers, like those shown in figure 11-29. These joggers are simply metal plates that move back and forth when the press is in operation and keep the stack even by jogging (pushing) each sheet in place as it is released from the delivery grippers and falls to the delivery platform. You position these joggers at the sides and back of the stack as shown in the illustration.

Some of the smaller presses are not equipped with automatic joggers. They have stationary guides which may be adjusted to accommodate any size of sheet that the press will run.

PRESS OPERATION

By now you should have a fairly good idea of the main types and kinds of offset presses and the functions of each. Although the operating parts discussed here vary from press to press, they are similar enough that once you are acquainted with the fundamentals, you should be able to understand the operation of any offset press.

Since there is a similarity in the operation of most presses, the following discussion will give you an idea of the sequence of operations involved in setting up and running a job on these machines.

Before Starting the Press

You oil the press at the beginning of the day as a rule and clean and grease the press at regular intervals in accordance with current OPNAV 4790.4 (3-M) instructions.

Before starting a run, you take ink from a can and work it out with a palette (ink) knife on a slab of stone or a piece of glass until the ink is rather fluid. If driers or modifiers are required, you can add them at this point.

As soon as the ink is worked out, you should distribute it evenly in the ink fountain. Next, mix the water and fountain etch in the correct proportions and fill the water fountain to the required level. Then you should run the press for a few minutes to allow the ink and water to distribute over the rollers.

At the beginning of the day, some press operators squeeze a sponge wetted with fountain solution above the water rollers, moving the sponge back and forth to distribute the solution evenly. They repeat this process four or five times until the rollers are sufficiently damp. If the same sponge is used for the same number of times, you will obtain fairly consistent results when the fountain solution on the rollers is distributed by hand. With a little experience, the press operator can tell when the ink and water distribution is correct.

Mounting the Plate and Blanket

You next take the plate to be run, measure it with a micrometer to determine the amount of packing required, and mount it on the plate cylinder. It is unnecessary to change the blanket each day; once it has been mounted, no further adjustments will be required until it becomes damaged or worn.

Setting the Feeder

Now you set the piling bars; and jogging the paper, load it onto the feed table, placing it a fraction of an inch off center. After raising the stack to operating height, set the metal support fingers against the back of the stack.

To keep from wasting good stock, you should add 30 to 40 sheets of waste paper to the top of the paper stack; this waste paper will be used during the make-ready operation.

If necessary you can set the caliper so that it will allow one sheet to pass onto the feedboard but will bind if two or more sheets are fed, and adjust the tension on the wheels that control the sheet as it is carried down the feedboard. Now make a preliminary setting of the side guide and other operating parts of the feeder and run one sheet through the press, stopping it just before the sheet is released by the delivery grippers. At this point, you set the joggers and the delivery platform to conform to the size of the sheet.

Printing a Trial Sheet

Next you clean the plate with a sponge and water and start the press rotating at a slow speed. Now you can move the dampener form rollers into contact with the plate and let the press run for about 30 seconds before lowering the inking form rollers. After about 1 minute, you raise the ink and dampener form rollers, stop the press, sponge the plate with water, and check it to see that all areas are properly inked and that the non-image areas are free of ink scum and tint.

If the non-image areas have picked up ink, you must clean the plate with a sponge dipped in the fountain etch and then adjust the fountain for a more adequate supply of fountain solution.

Local scum that cannot be removed by sponging with water must be carefully etched away with concentrated fountain etch and a small sponge. After the scum is removed, you sponge the etch off with clear water.

Then you start the press again, lowering the water and ink form roller as before. This time, turn on the vacuum pump and start the sheets feeding through. As the first sheet reaches the front guides, push a pressure lever to put the press on the impression. (This operation varies, depending on the type of press.) You should allow four or five make-ready sheets and one clean sheet to feed through the press. Then stop the feeder, but allow the press to continue to run while you examine the printed press sheet for position, color, errors, and defects. You will have to repeat these make-ready steps more than twice until everything is correct.

Making Corrections

After checking the press sheet, you adjust the press as required to provide the proper ink and water distribution. You may also adjust the tension between the blanket and impression cylinders if necessary.

It will seldom be necessary for you to correct the plate itself; but if such corrections are necessary, stop the press, apply a thin coating of gum arabic to the plate, and fan it dry. You can then add fine lines or other detail by scratching through the gum with a sharp needle or scraper and rubbing the engraved lines with an inky rag.

To fill in broken rules or lettering, you generally sponge the plate locally with water to remove the gum, then fan it dry and add the corrections with a hard lead pencil or litho crayon. After doing this, apply plate etch to the exposed areas, wipe them dry, then gum the plate and fan it dry again.

You can remove unwanted marks with a snakeslip or red rubber eraser, applying concentrated plate etch locally to desensitize the exposed metal, then sponge with clean water.

Positioning the Image on the Sheet

The position of the image on the sheet depends on the location of the image on the plate, the position of the plate on the cylinder, and the feeder setup.

If the image prints slightly crooked on the paper, you may be able to straighten it by setting one of the front guides slightly ahead of the other in the manner already discussed.

If more movement is required, however, you must shift the plate on the cylinder. On some presses, you can shift the plate by loosening the lock and tension screws at the tail edge of the cylinder and adjusting these screws on the opposite edge. Other presses require that the plate clamps be loosened and that the plate be shifted manually. Never force the plate during these operations, as too much tension may tear it or stretch it out of shape.

Centering the Image Sidewise

If the image is slightly off-center sidewise, you can generally adjust the image position by moving the side guide or with side adjusting screws in the plate clamps. If the adjustment is very large, it may also be necessary for you to move the feeder pile, the side guide, and the delivery joggers to keep them all in alignment.

Raising or Lowering the Image

If it is necessary to raise or lower the image on the paper, you may move the front guides for slight movements or shift the body of the plate cylinder. Since the plate is attached to this section, moving it changes the location of the image on the paper.

You must release the cylinder body from the gear by loosening bolts at the end of the cylinder and then move the cylinder forward or backward the required distance.

Final Preparation

If the plate has been moved during make-ready operations, you must always clean the blanket with blanket wash. If the blanket appears tacky after washing, dust it with talcum powder and wipe the excess powder off with a rag. Then you set the counter (a device that keeps a running record of the number of impressions made), sponge the plate with water, and start production.

Examination During the Run

During the run, you should examine a press sheet at regular intervals, removing a sheet from the delivery pile about every 60 to 100 impressions. Also watch ink distribution and register, adjusting the ink fountain and water until the required balance is obtained.

It is necessary to keep a close check on the register of the job if the image of another plate will be added to the press sheets you are running. In many cases, the stripper cuts slits in the negative layout so that small lines will print on the plate in such a position that they will run off the edges of the paper. If such lines are provided, you can use them in checking registration on the press sheets of this run and those to follow.

If such marks are not provided, you could pencil them in on the plate. Once you have established the required image position, take one of the printed sheets and match it against the image on the plate. Then make one or two short marks on the plate at the edges of the sheet. When you start the press, these marks will take ink and print lightly on the extreme edges of the press sheet. And although they will not be particularly noticeable on a single sheet of paper, they will show up readily when several sheets are stacked together. They will enable you to check the register by simply looking at the printed line they form along the edge of the stack of press sheets.

Clean-up Operations

After the press run is completed, you stop the press, gum the plate, and fan it dry. Now transfer the plate to a table and wash the image out with solvent. After this, rub a thin coating of asphaltum into the image areas and store the plate in a cool, dry place for future use if required.

You then wash the blanket with blanket wash or a suitable solvent and prepare the press for the next plate.

At the end of the day, you generally remove all ink from the fountain and clean the fountain, rollers, and blanket. Unless these parts are cleaned thoroughly, the ink will dry hard and cause future trouble. Roller wash or other suitable solvent may be used for this purpose. You will often need to wash the blanket with both blanket wash and water to remove all ink and gum deposits.

You also clean the cloth-covered dampening rollers with water, and (when they are extremely dirty) with a commercial cleaning solution. You must change the roller covers when they get too dirty to do their work effectively.

SAFETY HABITS AROUND THE OFFSET PRESS

Accidents are the result of doing things the wrong way. Safety practices and procedures should become a habit from constant observance of safe procedures.

First aid and medical treatment should be obtained for all injuries, no matter how small. This serves as a guard against infection and promotes healing.

CLEANLINESS

Sloppy cleaning habits and disregard for putting things in their proper places can lead to many accidents. The following is a checkoff list for general use. You should add items that are of value in your own shop.

1. Are oil drip pans and oil troughs empty or packed with absorbent material to prevent lube oil from spreading over the deck?
2. Are safety containers for solvents available and in use?
3. Are metal rag containers being used?
4. Are waste containers for paper provided and used?
5. Are there no ink cans on floor or platforms?
6. Are no tools left on walkways?
7. Are there no items of wearing apparel hanging on the control stations or press frame?
8. Are rollers properly racked so as not to come loose?
9. Are the floor, platform, and steps free of grease and oils?
10. Are areas around the presses free from litter?

SAFETY IN PRESS OPERATION

The correct way is the only safe way in press operation. Personal safety factors, as well as mechanical and general shop conditions, should always be considered. Whether doing maintenance or operation, you should comply with current *Safety Precautions for Forces Afloat*, OPNAV 5100.19A. In addition you should check your procedures to see that you observe the following practices.

1. Shirts must be tucked into trousers at all times; sleeves should be rolled up or buttoned at

the cuff to ensure that material cannot be caught in the moving parts of the presses (gears or rollers) or on projecting levers. If aprons are worn, they must fit snugly and be tied lightly so that if they are caught on moving parts, the apron will come off without dragging the wearer into the machinery.

2. The desire to keep one's hands and fingers intact should take precedence over the wearing of jewelry.

3. Leaning against presses that are running or resting hands near moving parts invites disaster.

4. Do not carry tools in pockets, because they may drop into moving machinery or cause someone to slip on them if dropped on the deck.

5. Proper sized tools must be used when making adjustments so as not to round off bolt heads and damage equipment.

6. Unauthorized operation of a press that you are not familiar with is dangerous. Do not attempt to operate a press without having been instructed in complete detail.

7. Do not attempt to oil any press while it is running. Always stop the press to clear jams, to oil, to set and to make adjustments, to make repairs, or to clean. Always stop the press to do any cleaning of the plate.

8. Replace all press guards before the press is started.

Guards

Offset presses have safety guards included in their design. These guards are not to be removed. Some press operators, after operating the same press day after day, become very careless and do not use these guards. This is a very dangerous way of doing a job. Any piece of fast-moving machinery, such as an offset press, presents many ways to be caught and pulled into the works. If safety guards are missing, order new ones. If safety locks do not work, ensure that they are fixed promptly. Voiding a safety mechanism or precaution is an invitation to an injury or a mechanical breakdown. Safety must be your primary concern in all areas. When working around the areas listed below, you should be particularly careful:

1. Cylinders and rollers
2. Between the blanket cylinder and the plate cylinder
3. Gears at the edge of the plate and blanket cylinders
4. Chain delivery

In addition, you should check your particular press for all exposed gears and cylinders and other places that could catch a finger or piece of clothing.

Press Controls

As a press operator, you should be familiar with all operating controls and the exact placement of the switch stations before starting any press. You should also know the location of the master switch, the fuse box, and the speed control adjustment.

Making sure that everyone is clear of the moving parts of the press before pushing the run, inch, or reverse buttons can save a lot of pain and suffering for an unsuspecting person leaning on the machine out of your line of sight. Always make sure the safe button is locked in when you are working on a standing press while cleaning, adjusting, or repairing it.

Make sure you use the correct button when inching or reversing the press. When you are removing or replacing a plate or blanket, this may mean the difference between your having a short or a normal finger.

Washing Operations

You should always use caution when using cleaning solvents to clean the ink fountain, blankets, plates, rollers, and other parts of the press. The following are precautions that should be followed when you are working with solvents:

1. Do not smoke while using solvents.
2. Take only small amounts of solvent to the press and use only approved safety cans.
3. Avoid spilling a solvent on the deck; the deck would be slippery and the solvent would present a fire hazard.
4. Ensure adequate ventilation while using solvents.
5. Do not use solvents directly on your body to remove grease or ink. This may cause a skin irritation.
6. Always place rags and materials used in washing up in a safety-approved metal container until they can be dumped.

FIRE PREVENTION

Fire prevention emphasizes the importance of good housekeeping and the safe handling of toxic and flammable chemicals. The personnel in a lithographic press room should also know what fire prevention measures exist. Everyone should be familiar with the following:

1. How to report a fire
2. What to look for in making a fire prevention inspection of your immediate work area
3. How to use the fire equipment available
4. How to ensure that all hands are fire-prevention-conscious at all times

Basic Military Requirements, NAVPERS 10054-E1, discusses various types of fires and fire-fighting equipment. You should refer to it for further information on the subject.

FOR LIC CANDIDATES ONLY

The following information on classified material is required for LIC candidates only. LI3, LI2, and LI1 candidates are not required to read this designated section. However, junior LIs serving as LPOs may find the information of interest.

CLASSIFIED MATERIAL

Before handling classified material, you must become familiar with the contents of OPNAVINST 5510.1G.

Additionally, you must take special precautions while handling classified material during the printing and finishing operations, since there are many places in a printing press and other equipment where pieces of torn paper from a sheet jam or even full sheets can hide from the normal, quick visual inspection given in clean-up operations. For this reason, upon completion of a run of classified material, you must always check base and oil pan areas. Look particularly behind motors and belt guards. Inspect every dark corner under the press. Also check the cylinder gaps, around the feedboard area, and the delivery end of the press. You should make sure that no printed sheets are left in the feeder; and last, but not least, you should carefully clean the image off the blanket and impression cylinder, because it is possible to read the image in these areas when the press is left standing. The blanket or impression cylinder may also produce a ghost of the old image on the next sheets printed when a new job is put on the press.

Burn bags should be used for waste material at all times when you are running classified jobs. Arrangements should also be made for the required disposal of metal plates and the negatives if the job is a one-time-only run.

SUMMARY

The offset press may be divided into three main parts: the feeder, the printing unit, and the delivery unit. The inking and dampening systems are a part of the printing unit.

The operation of each of these units is mostly automatic, once the press is set up. The adjustments involved in setting up the press for a new job are known as makeready or press preparation.

At the beginning of the day, the operator oils the press. Then the press operator fills the ink and water fountains and runs the press for a few minutes to allow the ink and water to distribute over the rollers.

Next, the press operator clamps the plate on the plate cylinder, adding sheets of paper packing behind it, if necessary, to obtain the proper printing pressure between the plate and the blanket.

The blanket must also be mounted and underpacked, but once this has been done, further blanket changes will be unnecessary unless it becomes damaged or worn. The pressure between the blanket and impression cylinder must be adjusted if the stock to be run is thicker or thinner than that used for the previous job.

Besides adjusting the ink and water for even distribution, the press operator must set the feeder and delivery units for the size of the sheet being run. The press operator must also adjust certain devices on the feedboard that control the sheet as it is carried to the printing unit.

Starting the press again, the press operator pushes a lever to lower the water rollers to the plate. A moment later, the press operator drops the inking rollers by a similar method. As soon as the plate has inked, the press operator prints a few trial sheets.

The press operator checks these sheets for defects, ink distribution, and the position of the image and, if necessary, stops the press and makes corrections. After corrections have been made, the operator is ready to start production.

Most presses have two sets of starting and stopping buttons. One set controls the press, and the other set controls the vacuum pump, which supplies the suction and blast for the feeder. These buttons and other control levers are generally located on the near (operator's) side of the press. Larger presses have additional operating control buttons located at the delivery end of the machine.

The press is set in motion when the start button is pushed. But the sheets do not begin feeding through the press until the operator turns on the vacuum pump and (on some presses) pushes a lever that sets the feeder in motion.

When the feeder is turned on, blowers separate the top sheets in the paper stack (which has been loaded on an automatic elevating feed table). Suction feet then catch the top sheet and move it to the edge of the feedboard, where it is caught by a set of forwarding wheels and forced onto moving conveyor tapes. These tapes carry it to the end of the feedboard. There it is squared for register by the side and front guides.

Just before the sheet reaches the front guides, the impression goes on automatically or the press operator pushes a lever that puts the press on impression so that the image will print.

The front guides then lift (or recede) to release the sheet, and a set of grippers (contained in a recess in the impression cylinder) close on the edge of the sheet and draw it through the printing unit.

As the cylinders revolve, the plate is carried first against the water rollers, then against the inking rollers, and finally against the blanket. The blanket receives the inked image and transfers it to the paper that is forced against the blanket by the impression cylinder.

As the sheet emerges from the printing unit, the cylinder grippers release it to a set of traveling delivery grippers. These grippers carry the sheet to the end of the press and deposit it on a delivery platform. Automatic joggers keep the stack of printed sheets even, and an automatic lowering device lowers the platform as the sheets are delivered.

At the end of the run, the press operator removes the plate and prepares it for storage. Then the operator washes the blanket and sets up the press for the next job to be run. At the end of the day, the ink is removed from the fountain and the press is washed and cleaned thoroughly.

Operating parts and adjustments vary from press to press, but if a press operator understands the basic operating principles, he can switch from one model to another with a minimum of instruction.

Fire prevention and safety are paramount to a lithographer. Carelessness in either area can be dangerous. Always follow the rules.

Keep up-to-date on the regulations concerning the handling of classified material, and be ever mindful of your responsibility.

Multilith offset presses will be presented in the next chapter.

CHAPTER 12

MULTILITH PRESSES

Now that you have completed your required assignments in the platemaking section of your shop, you are ready to use the offset plates produced there to reproduce the press sheets on an offset press. A majority of Navy print shops are equipped with Multilith offset presses. If the job you are to print is stripped for one of these presses, you should proceed to that press with those plates.

Small offset presses, such as the Multilith 1330 and/or 1360, are often referred to as duplicators. These duplicators operate on the same principle as large offset presses. They are, however, easier to operate and require less floor space than the larger presses.

MULTILITH 1330 AND 1360

The Multilith 1330 and 1360 offset presses (see figs. 12-1 and 12-2) are manufactured by AM Multigraphics, a division of AM International. These offset presses are similar in principle and operation.

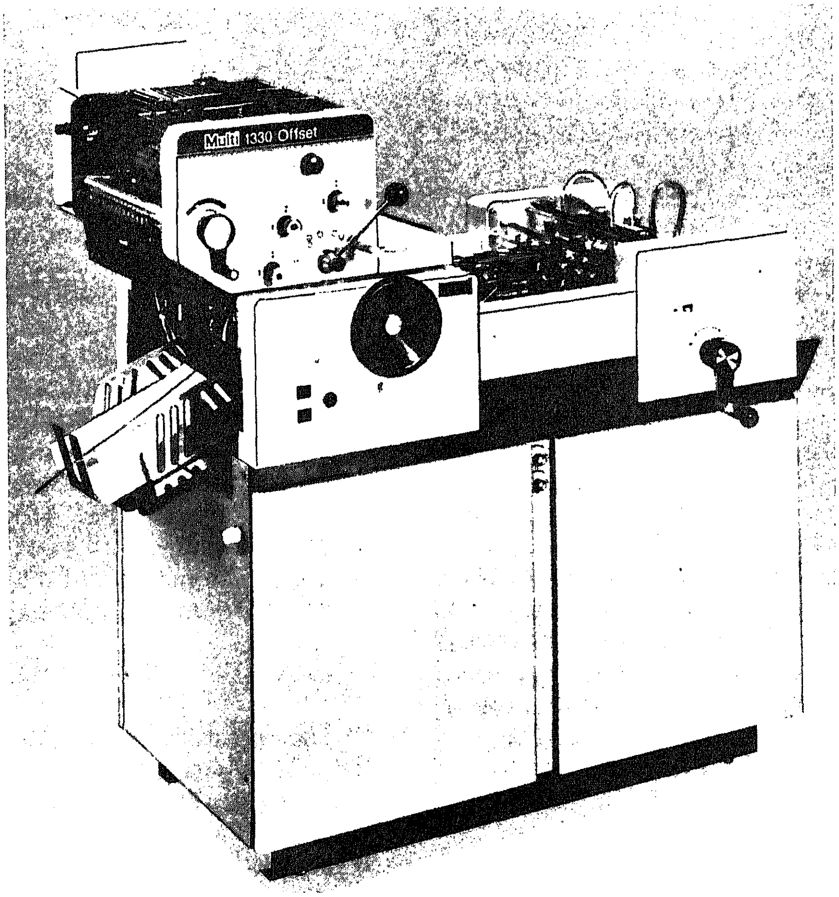

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Figure 12-1.—Multilith 1330 offset press.

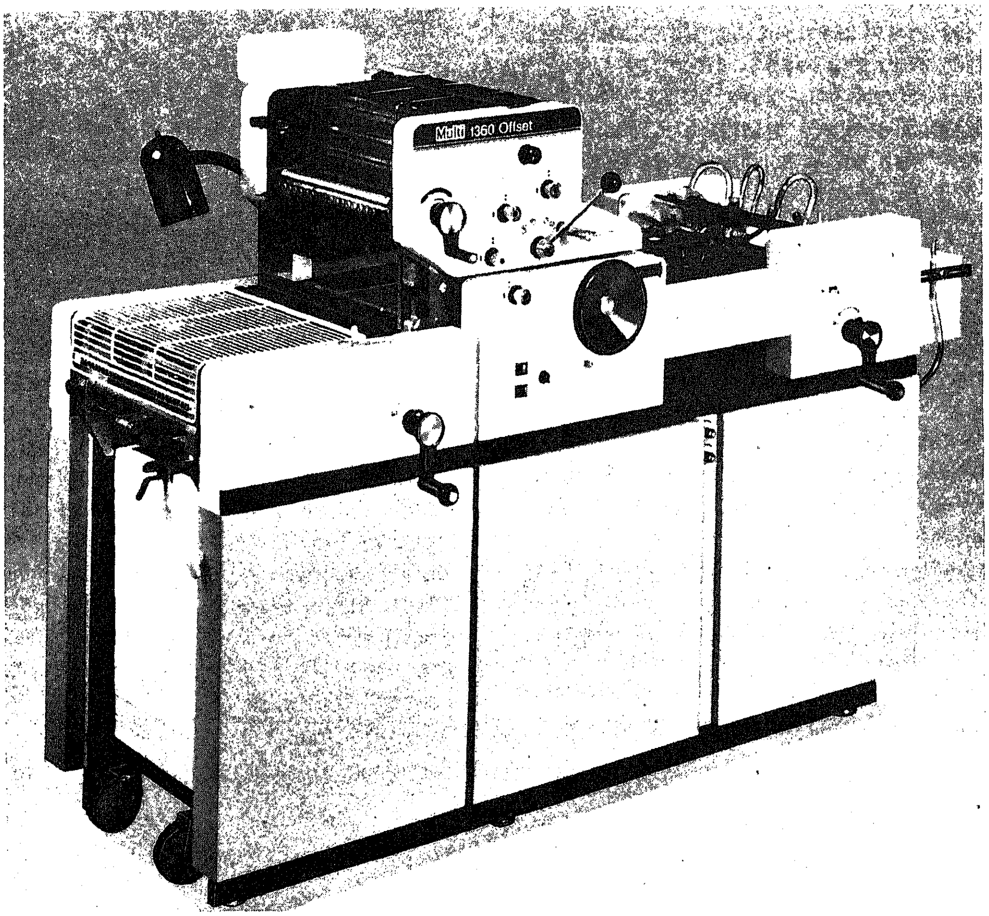

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Figure 12-2.—Multilith 1360 offset press equipped with a chain delivery unit.

PRESS SPECIFICATIONS

The Multilith 1330 offset press runs sheets as large as 13 inches by 17 inches and as small as 3 inches by 5 inches. Its maximum printing image area is 12 1/2 inches by 13 inches, with a maximum sheet lead-edge gripper margin of five-sixteenths of an inch. The 1360 offset press runs the same size of press sheets as the 1330. The only difference is in the maximum printing image area; the maximum printing image area of the 1360 is 12 1/2 inches by 16 1/2 inches.

Generally, all references in this chapter pertain to the basic 1330 offset press. This is because, with the exception of certain minor adjustments, the operator controls are basically the same for both the 1330 and the 1360 offset presses.

The operating speed of the press is usually designated as impressions per hour (IPH), and the press is normally run at 10,000 IPH with chain delivery and 11,000 IPH for tray delivery. When the sheet being printed is over 14 inches long, it is recommended that the press be run at a maximum of 6,000 IPH. Stocks from 11-pound bond to 110-pound card stock can be run through the press. The capacity of the feeder unit is 5,000 sheets of 20-pound bond paper.

OPERATOR'S CONTROLS

The operator's controls and press components that will be discussed in this chapter are shown in figure 12-3. The sheets are fed through the press when the machine start/stop push buttons and paper-feed switch are turned on; then the blower and vacuum controls are adjusted so that the sheets are fed evenly and consistently into the press.

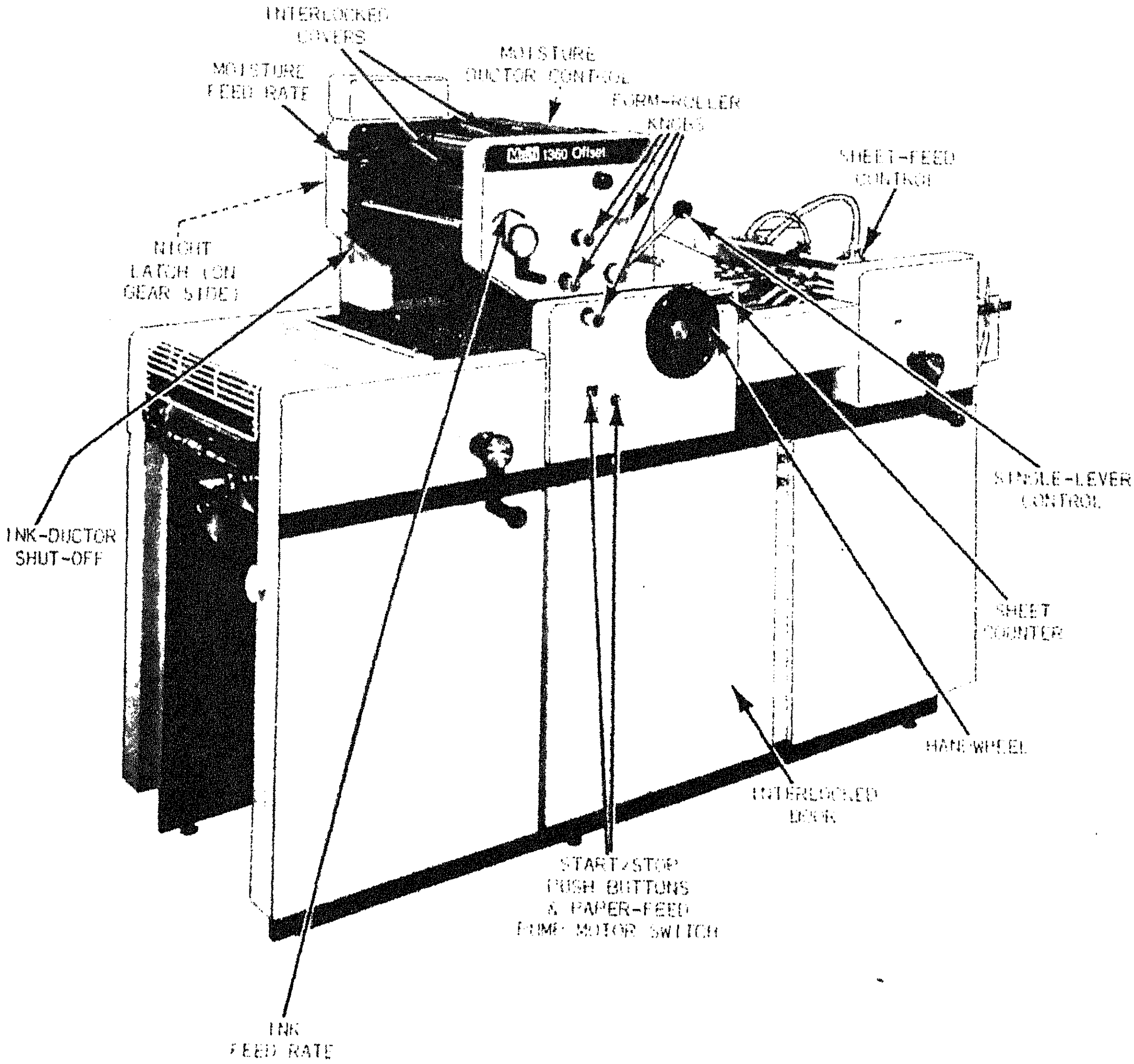

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Figure 12-3.—Operator's controls and press components.

A lever, called the single-lever control operates the printing unit. There are four lever positions: OFF, MOIST, INK, and PRINT (fig. 12-4).

The sheet counter registers up to 99,999 impressions and can be manually reset by turning the knurled wheel. The counter only registers the sheets that pass through the printing unit; it does not count cylinder revolutions.

The speed control knob is located at the delivery end of the press. The speed control should be adjusted (changed) only when the press is operating (running).

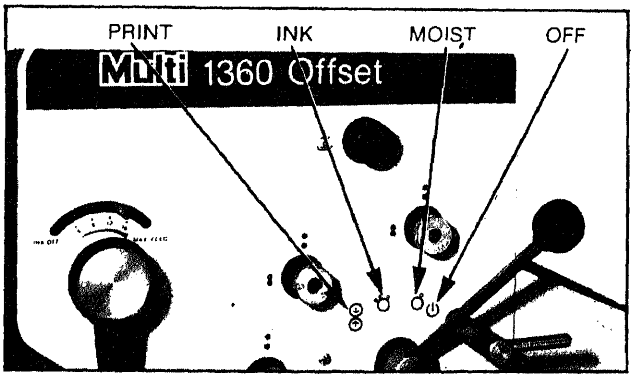

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Figure 12-4.—Single-lever control.

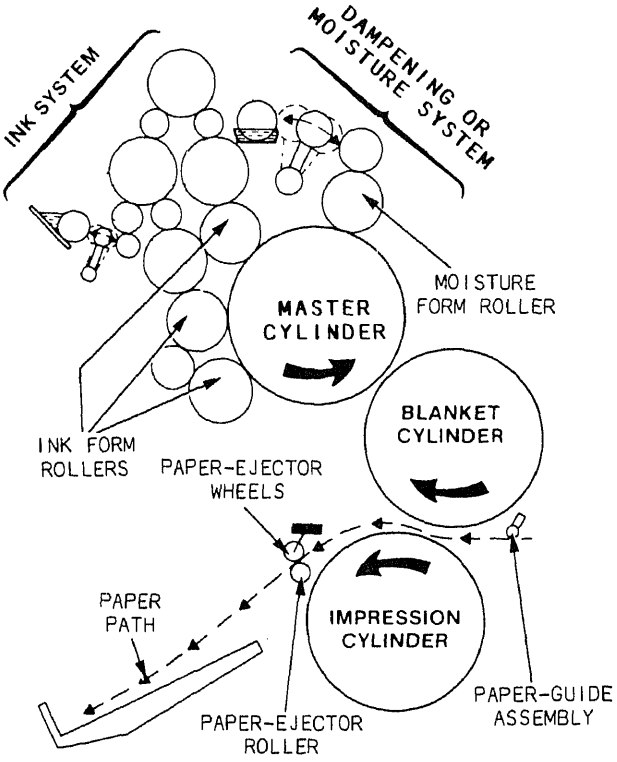

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Figure 12-5.—Printing unit.

MOISTURE (REPELEX) SYSTEM

Figure 12-5 shows a diagram of the printing unit of this press, and figure 12-6 shows a close-up of the moisture system. The moisture system is identified by the manufacturer as the Repelex unit, which is the trade name of the fountain solution manufactured by AM Multigraphics.

The moisture (or dampening) (Repelex) system consists of four rollers, a water fountain, and a large plastic bottle which acts as a reservoir for the fountain solution. The fountain solution is prepared according to the instructions for its use and poured into the bottle, which is then placed in the fountain in an inverted position. As the fountain solution is used from the fountain pan, a valve within the bottle releases more fountain solution from the bottle. This will replenish the supply and keep the fountain solution at a constant level in the fountain pan.

The moisture rollers of the moisture system shown in figure 12-6 include a moisture (molleton-covered) form roller, a (metal) oscillator (rider) roller, a (molleton-covered) ductor roller, and a (knurled) water fountain roller.

When the press is in operation, the knurled fountain roller revolves in the fountain pan, picking up a thin film of fountain solution, which it yields to the molleton-covered ductor roller. The ductor roller swings back and forth, alternately touching the fountain roller and the rider roller.

The rider roller receives the fountain solution from the ductor and distributes it to the form roller. The form roller, of course, contacts the plate, keeping it moist in the non-image areas.

The moisture form roller control knob, shown in figure 12-7, is used to raise or lower the form roller. To drop the form roller, you simply give the knob a quarter of a turn counterclockwise (pointing it toward the delivery end of the press) to the ON position. The contact action of the form roller to the plate cylinder is now controlled by the single-lever control. To raise the roller, you should move the knob back to its vertical position, OFF.

The fountain solution supply is regulated by a ratchet which controls the number of revolutions per minute of the fountain roller. To increase the supply, you must push the moisture feed rate control, shown in figure 12-7, to a position in the range of 4 to 6. Pushing the lever in the opposite direction decreases the supply, and if the lever is pushed all the way down (to the lowest number),

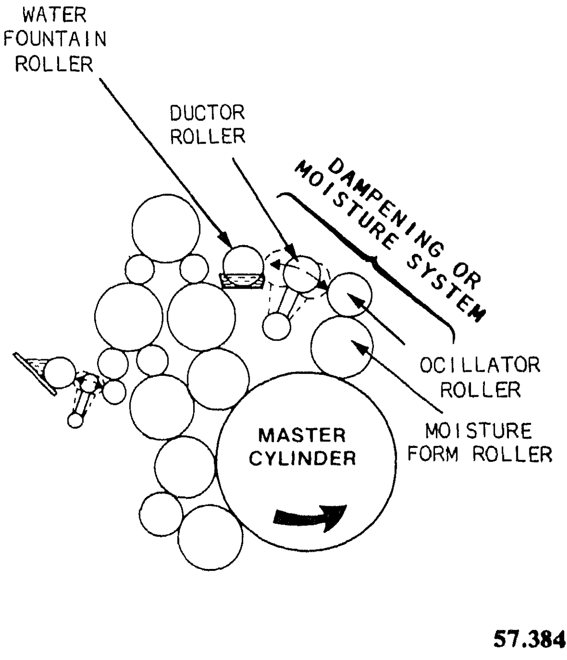

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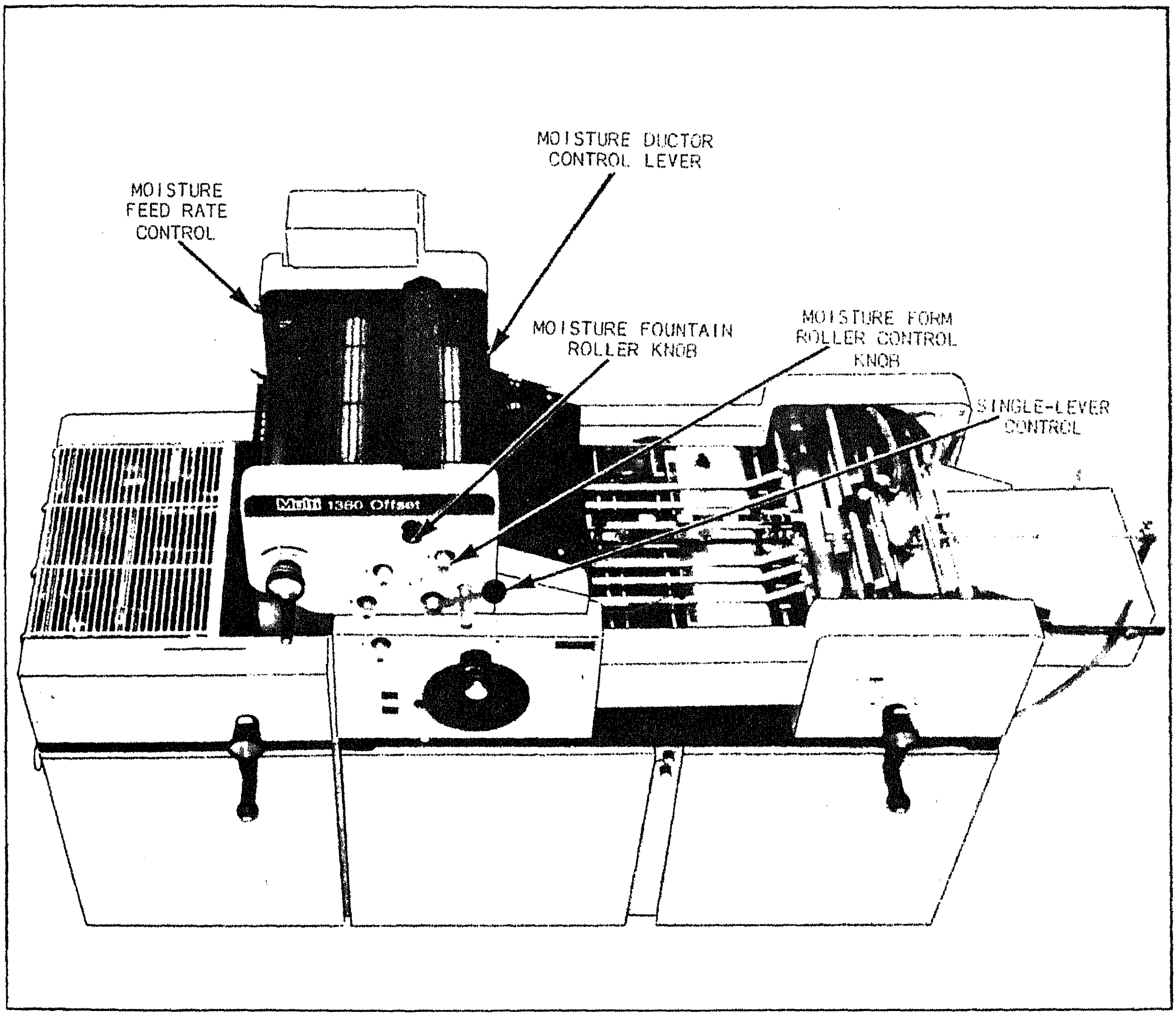
Figure 12-6.—Moisture system.


MOISTURE FEED RATE CONTROL
MOISTURE DUCTOR CONTROL LEVER
MOISTURE FOUNTAIN ROLLER KNOB
MOISTURE FORM ROLLER CONTROL KNOB
SINGLE-LEVER CONTROL
Multi 1360 Offset

57.385X

Figure 12-7.—Moisture system controls.

the fountain solution supply is shut off completely.

You can also cut off the solution supply by moving the moisture ductor control lever (fig. 12-7) toward the feeder end of the press. This breaks the contact between the ductor and the fountain roller.

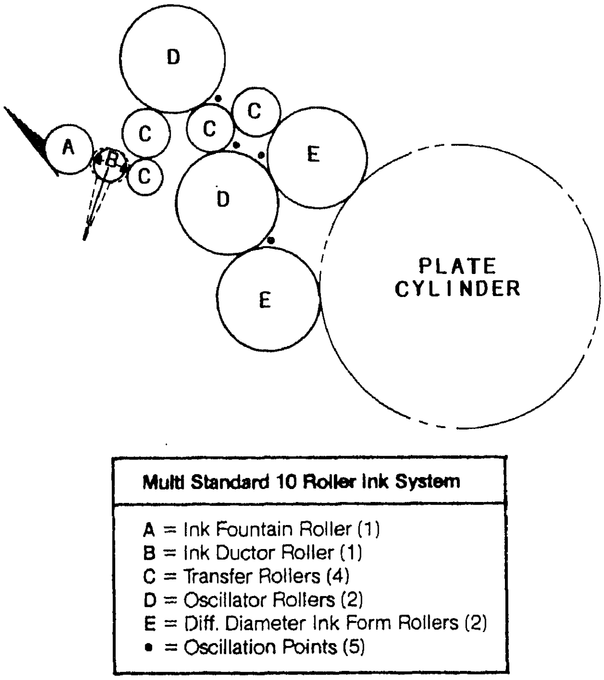
The rollers dry out if the press is shut down for any length of time. Therefore, at the beginning of the day or after a long shutdown period, most operators distribute fountain solution over the rollers with a sponge. The sponge is soaked in fountain solution, and with the press running, you can slowly move the sponge above the oscillator roller. As you do this, lightly squeeze the sponge to drip fountain solution onto the oscillator roller and into the moisture roller system. You should repeat this procedure four or five times or more until the rollers are damp enough to begin the press operations. During a press run, you can quickly and evenly increase the fountain solution supply to the rollers by rapidly making one or two clockwise turns of the moisture fountain roller knob (fig. 12-7) at the time the ductor roller contacts the fountain roller.

INKING SYSTEM

In figures 12-8 through 12-10, you can see how the inking systems that are available for the model 1330 or 1360 vary from 10 to 15 rollers. The larger rollers with their increased ink-carrying ability directly affect the press ability to print large solids and halftones. Therefore, the larger the press rollers and/or the more of them you have in the inking system, the better the ink coverage will be.

The ink fountain consists of a steel blade connected to a metal roller in such a way as to form a reservoir, or trough, for the ink. The fountain roller is covered with a thin film of ink as it revolves in the fountain. It gives up a part of this ink each time the ductor roller touches it. The ductor roller, in turn, transfers the ink to the distributor roller. See figures 12-8 through 12-10 for the path of the ink to the form rollers and to the image on the plate for a standard configuration.

Refer to figure 12-11 for the inking system controls. The form rollers are dropped into position by turning the ink form roller control knobs to the left. The rollers actually do not contact the plate until the single control lever is placed in the ink position.

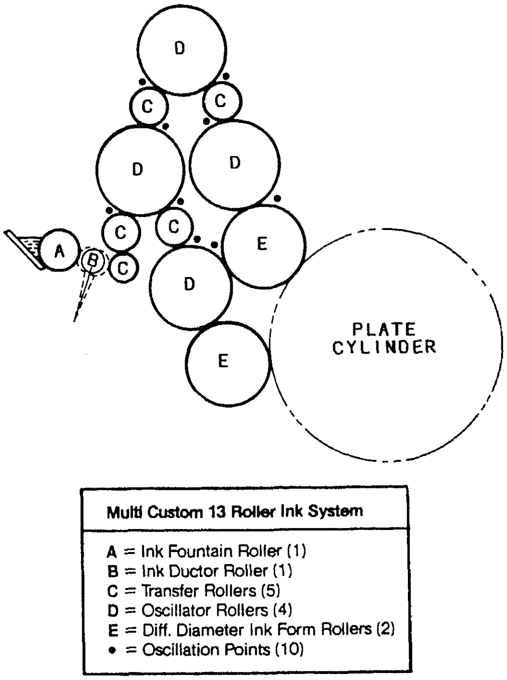


Multi Standard 10 Roller Ink System

A = Ink Fountain Roller (1)
B = Ink Ductor Roller (1)
C = Transfer Rollers (4)
D = Oscillator Rollers (2)
E = Diff. Diameter Ink Form Rollers (2)
• = Oscillation Points (5)

57.386X

Figure 12-8.—Roller diagram of Standard Ink System.



Multi Custom 13 Roller Ink System

A = Ink Fountain Roller (1)
B = Ink Ductor Roller (1)
C = Transfer Rollers (5)
D = Oscillator Rollers (4)
E = Diff. Diameter Ink Form Rollers (2)
• = Oscillation Points (10)

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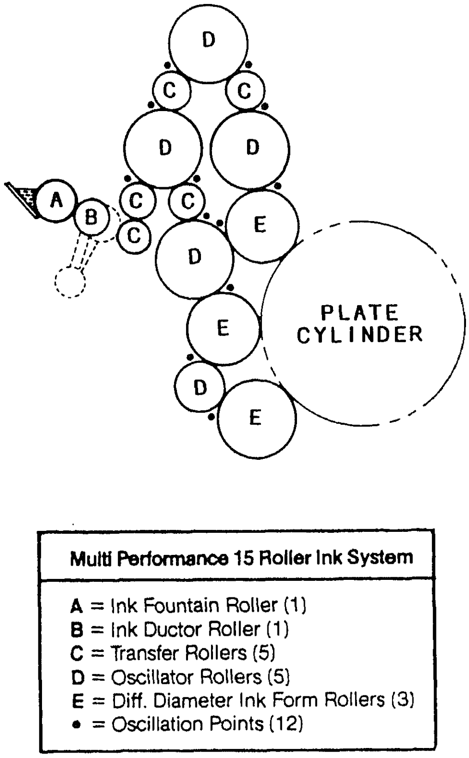
Figure 12-9.—Roller diagram of the Custom Ink Sytem.



Multi Performance 15 Roller Ink System

A = Ink Fountain Roller (1)
B = Ink Ductor Roller (1)
C = Transfer Rollers (5)
D = Oscillator Rollers (5)
E = Diff. Diameter Ink Form Rollers (3)
• = Oscillation Points (12)

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Figure 12-10.—Roller diagram of the Multi Performance Ink System.

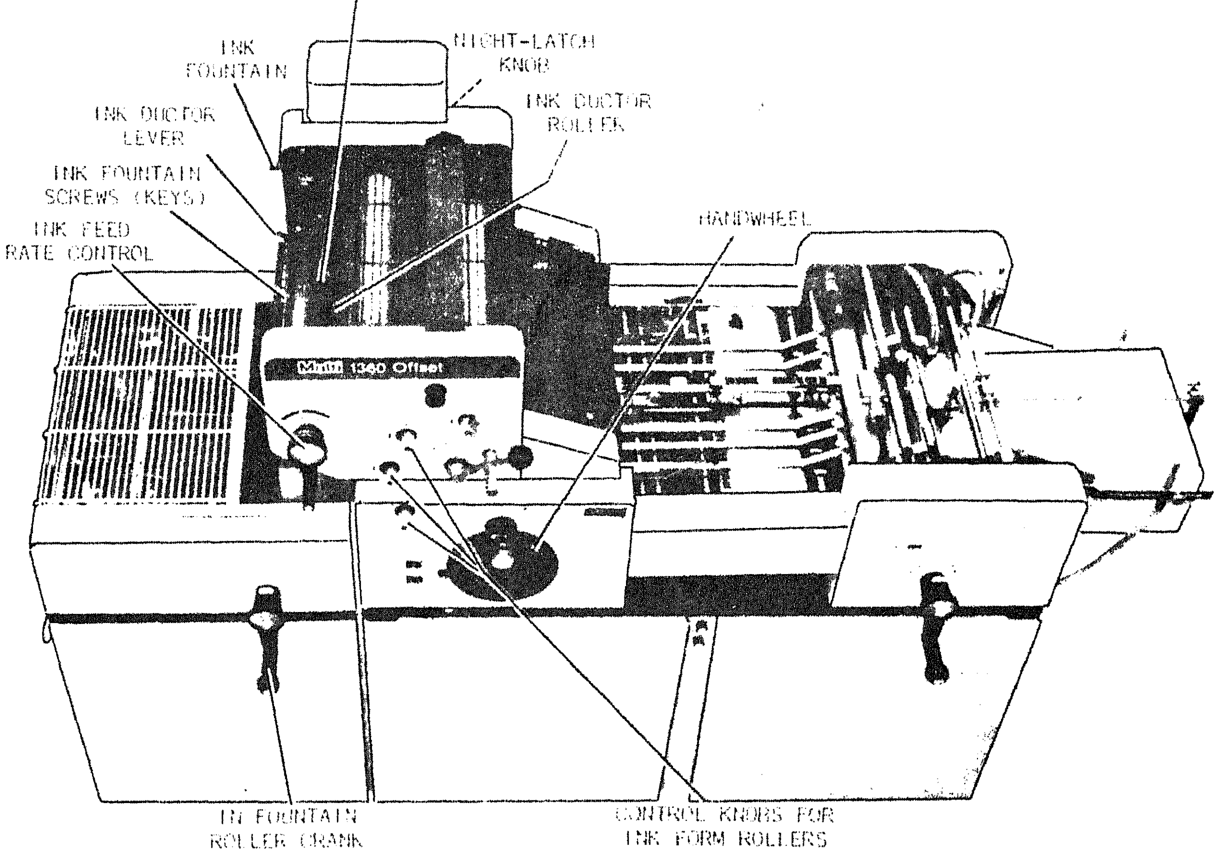

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Figure 12-11.—Ink system controls.

On the far side of the press is a night-latch knob, or disengaging lever. You should turn this lever to its vertical position to release the tension on the ink form rollers when you shut down the press at night or when the press is turned off for any extended period of time. Before you prepare the inking system for operation, place the lever in the horizontal position.

To put ink in the ink fountain, you turn the press handwheel until the ink ductor roller is out of contact with the ink fountain roller. Then add ink to the ink fountain with an ink gun. During operation of the press, you may add ink as needed to assure a steady flow of ink to the fountain roller.

The ink fountain is provided with a row of ink fountain screws (adjusting screws or keys). The ink fountain screws are used to adjust the flow of ink to the fountain roller. When setting the screws at the beginning of the run, you should start in the center and work toward the ends of the fountain. To ensure that the ink ductor roller does not contact the fountain roller during the time you are adjusting the keys, you should place the ink ductor (shut off) lever in the up position. Now, as you turn the ink fountain roller counterclockwise with the ink fountain roller crank, adjust each ink fountain screw until you have an even film of ink on the entire ink fountain roller. Turning the screws in (clockwise) reduces the flow of ink and turning them out (counter-clockwise) increases the flow of ink. After you have adjusted the flow of ink to the fountain roller, turn the press handwheel until the ductor roller contacts the ink fountain roller. Turn the ink fountain roller crank a few more turns and check the film of ink on the ductor roller for smoothness and evenness. To obtain a smooth, even film of ink, you may need to make additional adjustments to the ink fountain screws.

The amount of ink flowing from the fountain roller to the inking rollers may be regulated by the ink feed rate control lever over a range of positions on the scale. Placing the lever on zero on the scale shuts off the ink supply. Moving the ink feed rate control lever to a higher number on the scale gradually increases the flow of ink. For an average press run, you should place the ink feed rate control lever about one-quarter up on the scale. When you are preparing the press for operation or if you require an extra amount of ink during a run, you turn the ink fountain roller crank counterclockwise a few extra turns by hand as the ink ductor roller contacts the ink fountain roller. To stop contact between the fountain roller and the ink ductor roller, you should move the ink ductor (shut off) lever to the up position.

BLANKET CYLINDER

The rubber press blanket is provided with punched holes which may be attached to hooks on each end of the blanket cylinder. Quick-change blankets will not attach to the tail clamp as the standard blanket does. The end of these quick-change blankets will tuck into the cylinder gap so that it will not interfere with normal operations of the press.

To attach the standard blanket to the cylinder, you should rotate the handwheel of the press by hand until the hooks in the lead blanket clamp are accessible. Attach the holes in one end of the blanket to the hooks of the lead clamp. Hold the trailing end of the blanket taut and turn the handwheel until the hooks on the trailing clamp become accessible. You should now attach the holes in the trailing end of the blanket on these hooks. After both ends of the blanket have been attached, stretch the blanket taut by tightening the clamp screws and securing them with locknuts. Run (operate) the press for about 30 to 40 impressions and then check the clamp screws for tightness. While you are running the press, it is possible that the blanket may stretch, causing the clamp screws to loosen. Therefore, you may have to retighten them.

It is not necessary to underpack (build up) the blanket with full sheets of paper placed underneath the blanket unless it is damaged or worn. You can, however, bring up isolated low areas on damaged blankets by spotting or underpacking them with small pieces of paper.

Most operators keep at least two blankets on hand at the press, rotating them periodically so that each blanket can have a resting period. This lengthens the life of the blanket. When a blanket

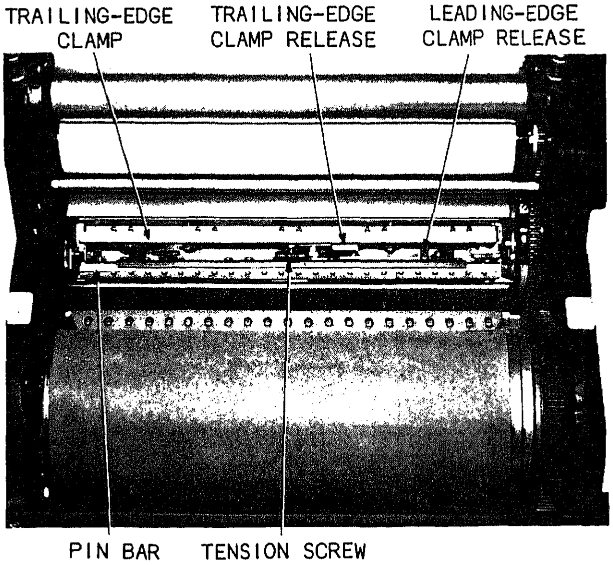
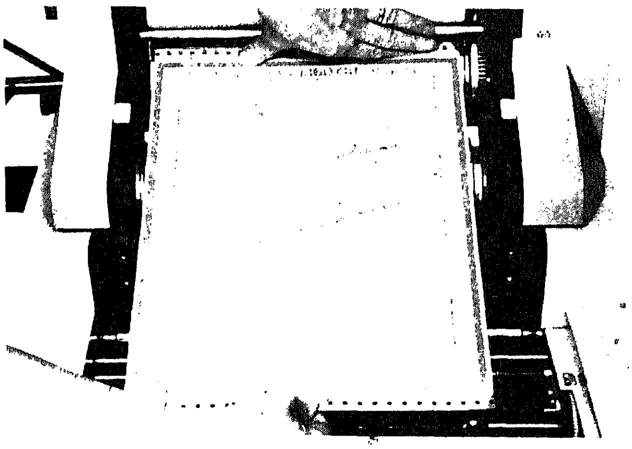


PLATE CYLINDER TURNED SO THAT CLAMP IS ACCESSIBLE.



INSTALLING PIN BAR PLATE AND FORMING LEADING EDGE OVER CYLINDER.

57.390X

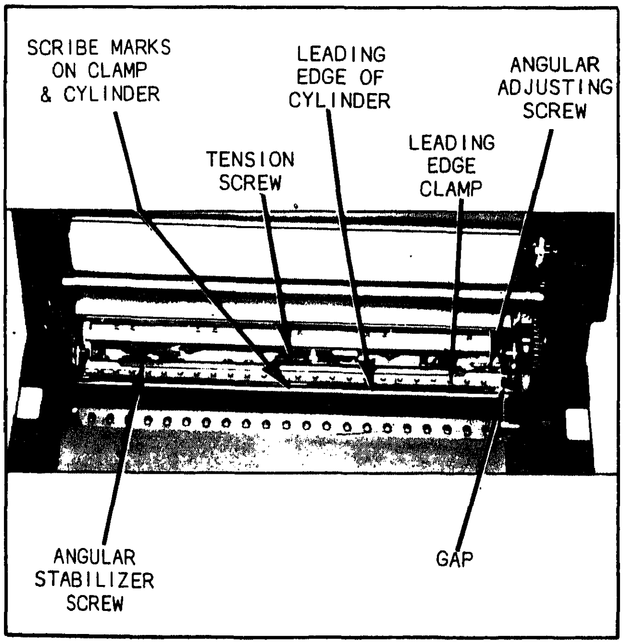
Figure 12-12.—Mounting the plate.

is not in use, a coating of dust bloom may form on its surface, so always clean blankets thoroughly with blanket wash and lightly dust the rubber surface with talcum powder before stowing the blanket or putting it on the press.

Mounting the Plate

Both the Multilith 1330 and the 1360 use plates made from metal, paper, or plastic. The most common style of plate used on these presses is the punched type. The holes in each end of the plate simply fasten over the pins on the pin bar of the plate cylinder. (See fig. 12-12.) Spring tension on the trailing-edge clamp normally holds the paper masters taut, although it is best to tighten the metal plate around the cylinder with the tension screw that is located on the tail clamp.

Some models of the press are equipped with a plate cylinder leading-edge clamp that accepts straightedge plates as well as the looped or punched type. To insert a straightedge plate, you must depress the clamp with one hand as you insert the plate into the clamp with your other hand. For other types of clamps that are available for your press, you should check with your AM Multigraphics dealer.



57.391X

Figure 12-13.—Angular adjustments on plate clamp.

Straightening the Plate on the Cylinder

If the image is not straight on the plate, it will be necessary for you to shift the plate on the cylinder so that the image will be square with the paper. You can twist the plate on the cylinder with the angular stabilizer (adjusting) screw (fig. 12-13). Loosen the tension screw and then turn the notched adjusting screw in one direction and screw the opposite adjusting screw in the opposite direction until the image is square with the cylinder.

Raising or Lowering the Image Less Than Three-Eighths of an Inch

To raise or lower the image less than three-eighths of an inch, you must loosen the clamp with a screwdriver wedged behind the handle of the release pin in one of the holes in the interposer ring, as shown in figure 12-14. Push the pin out of its hole (towards the cylinder) as far as it will go. Then the centerline of the micro-adjust scale is lined up with the scribe mark on the interposer ring.

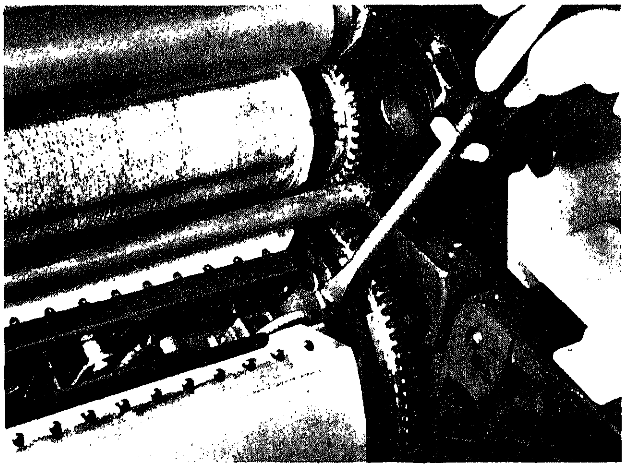


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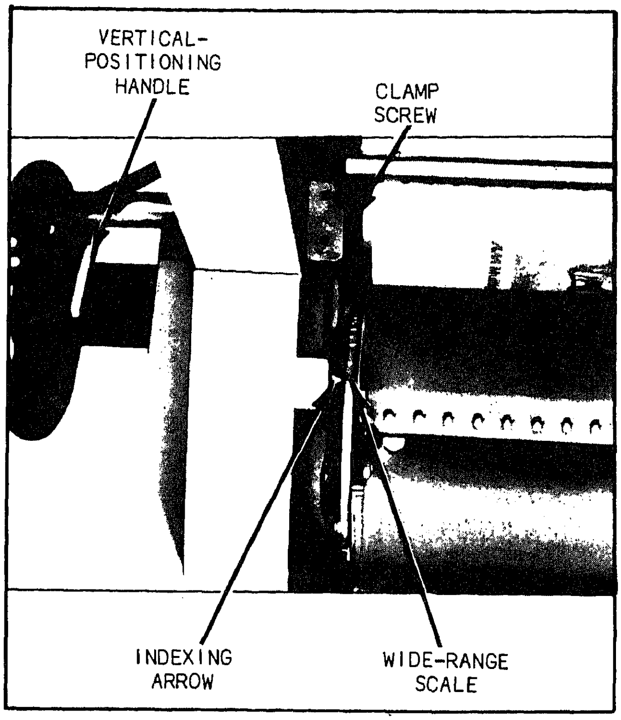
Figure 12-14.—Pushing release pin out of hole in interposer ring.



57.393X

Figure 12-15.—Wide-range adjustments, used to make large, vertical image relocations.

Next, you should turn the handwheel until the clamp screw on the cylinder (see fig. 12-15) is in line with the socket on the vertical-positioning handle. This alignment is made when the zero setting on the wide-range scale is lined up with the indexing arrow on the side casting of the press.

To engage the socket, you should push the vertical-positioning handle inward with the clamp screw. Then turn the handle (knob) about three-fourths of a complete turn counterclockwise to loosen the screw.

To raise the image on the sheet, you should use a screwdriver to turn the micrometer screw counterclockwise; to lower the image, turn the screw clockwise. The movement can be read from the micrometer scale, using the scribe mark on the interposer ring as a reference.

After you have made all adjustments, tighten the clamp screw by turning the vertical-positioning handle clockwise. Reset the cylinder so that the centerline of the micro-adjust scale again lines up with the scribe mark on the interposer ring.

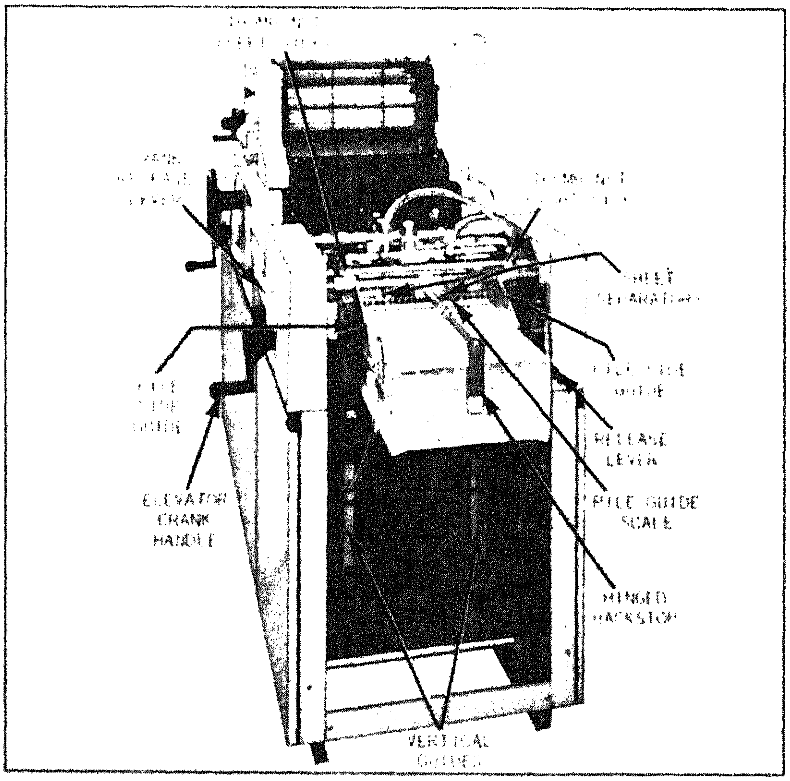


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Figure 12-16.—Locations of components and adjustments used for paper-loading and feeder-setup procedures.

Raising or Lowering the Image More Than Three-Eighths of an Inch

You should loosen the clamp with a screwdriver wedged behind the handle of the release pin and then push the release pin out of its hole (toward the cylinder) as far as it will go.

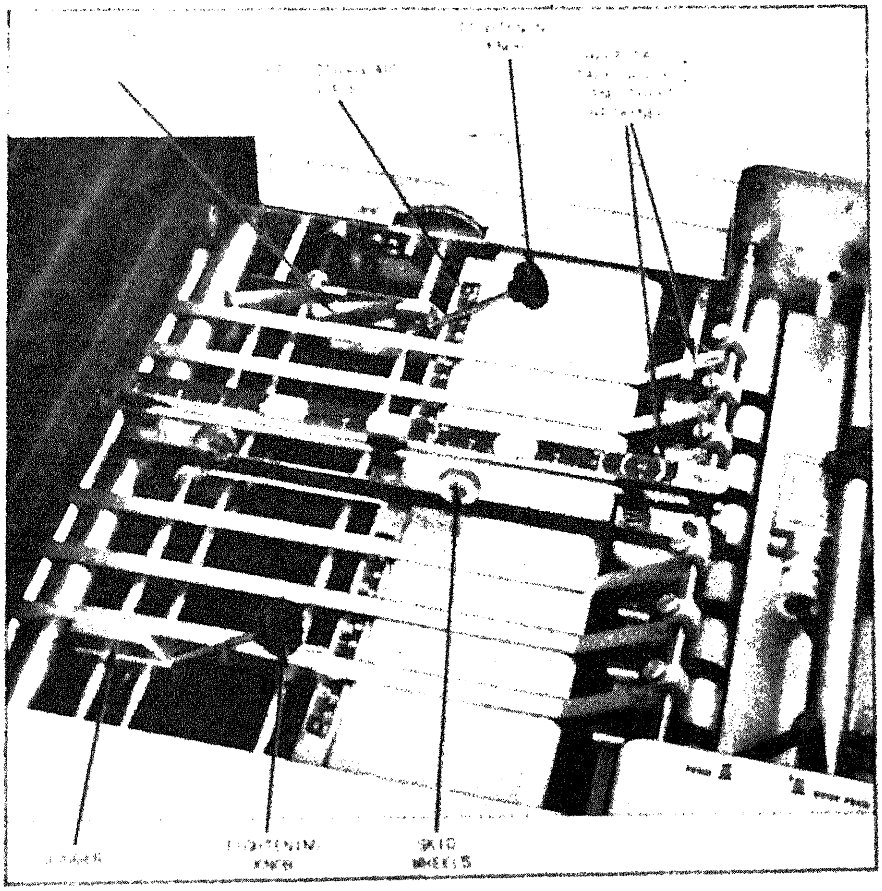
Next, you should press the vertical-positioning handle inward so that the socket holds the clamp screw. At the same time, move the handwheel as required, clockwise to raise the image and counterclockwise to lower it. The movement of the cylinder is read from the wide-range scale with the indexing arrow on the side casting used as a reference. Turn the vertical-positioning handle to tighten clamp screws; then reset the centerline.

AUTOMATIC FEEDER

The feeder consists of an elevating feed table, a register board, front and side guides, a pile-height bar, sucker feet, blast pipes, and various paper controls. These parts were described in chapter 11. When you are ready to set the feeder components, shown in figure 12-16, first measure off the width of the paper stock to be run. Lower the feed table by first holding back the crank release lever and then turning the elevator crank handle counterclockwise. The table is then lowered far enough that you can work on the adjustments.

Unlock the thumb nuts for the left and right pile side guides, lift the release lever, and align the pile side guides with the pile guide scale at the head of the feed table. Retighten the thumb nuts. The left and right vertical guides will align automatically as the pile guides are aligned because they are attached to each other. Loosen the thumb nut on the hinged backstop and move the backstop until it rests snugly against the trailing end of the paper pile. Next, move the sheet separators until they are one-half the distance from the pile guides to the center of the sheet.

To set up the register board (see fig. 12-17), you must first turn the handwheel, until the jogger



57.395X

Figure 12-17.—Register board.

moves to its full inward thrust on the register board. Then, loosen the tightening knobs for the spring side guide and jogger and align them with the register-board scale. Retighten the tightening knobs. Space out your sheet tapes and tape guides evenly from the spring side guide to the jogger, placing the tape's sheet retainers over all the tapes. Do not make your last adjustment until after you have placed a piece of paper on the register board flush against the stop fingers. Then, adjust the (tail) skid wheel so it will run just off the tail edge of the sheet.

Once you have set the jogger (the left side guide), place a sheet of the stock to be run on the register board. Move the stationary guide inward until the register spring of the spring side guide is compressed approximately one-sixteenth of an inch against the sheet. The register spring keeps the sheet in light contact with the jogger guide so that each sheet enters the printing unit of the press in the same position. Because the sheets enter the printing unit in the same position after being acted on by the jogger and spring side guide, they are in register from left to right.

If it becomes necessary to make minute adjustments to the jogger, you can do so later by using the micrometer disk (fig. 12-18). Raise the micrometer locking lever to release the micrometer disk and allow it to be adjusted. Turning the disk clockwise moves the jogger out to allow more margin on the left side of the sheet being run; turn it counterclockwise to allow less margin on the left side of the sheet.

Adjusting Suction and Blast

The press is set in motion with the machine start/stop switches, but the sheets of paper being run do not begin feeding until the operator turns on the vacuum pump switch. The vacuum pump switch activates the pump which supplies both suction (vacuum) and blown air, which is referred to as blast. When the vacuum pump switch is turned on, two blowers at the front of the paper stack and two blowers at the back of the paper stack provide a blast (blanket) of air which floats the top sheet in the pile. Two vacuum (suction) feet then dip down to pick up the top sheet and move it to the feeder end of the register board, where it is caught by two pullout rollers. These rollers force the sheet onto the conveyor tapes, which carry it down the register board to the printing unit.

The blower tubes, shown in figure 12-19, are attached to the piling bars by a metal clip or bracket. To get the necessary airflow pattern, the blower tubes must be correctly positioned. The figure shows a feeder with front and rear blower tubes correctly positioned for normal weights of paper stock.

When necessary, you can raise or lower the blower tubes by loosening the screw that holds the tube to the piling bar. Each blower should be moved until its top hole is just slightly above the top of the paper stack. The amount of blast

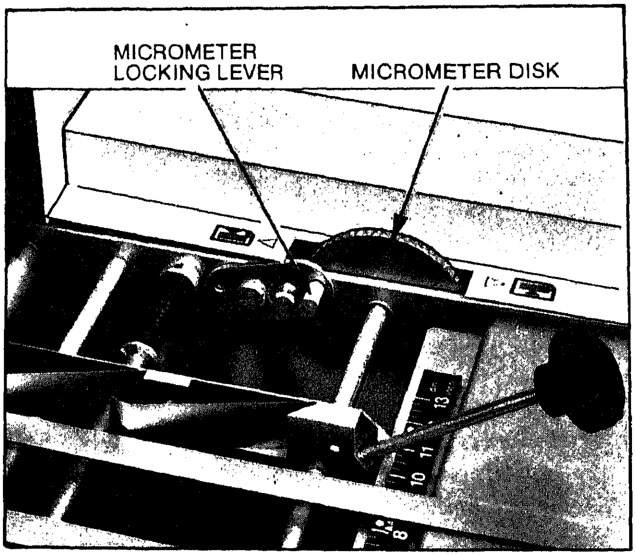


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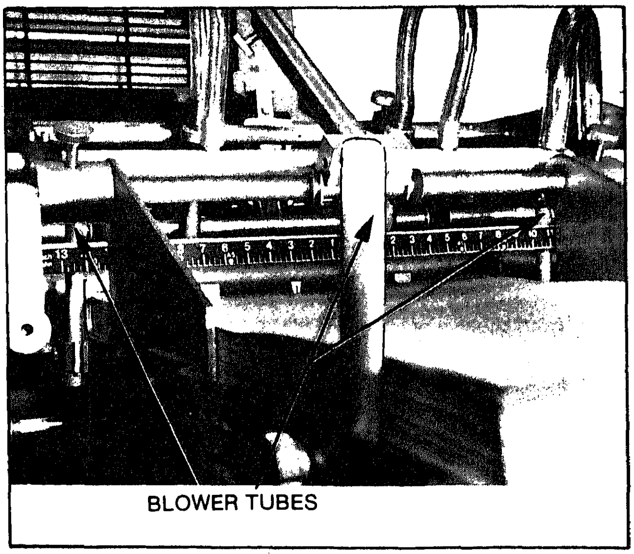
Figure 12-18.—The micrometer disk, used for making fine



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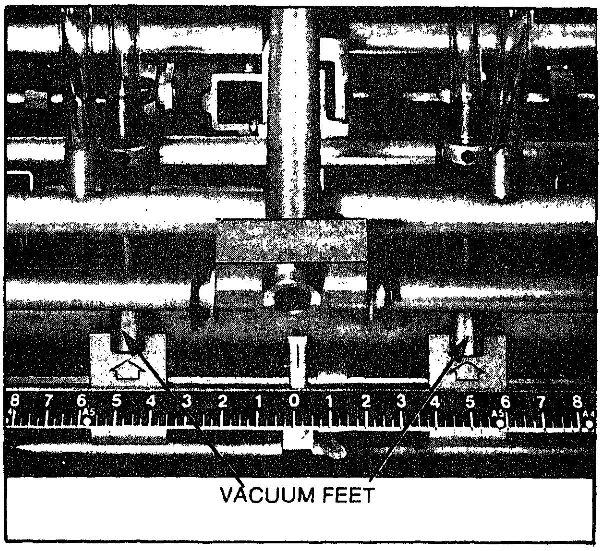

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Figure 12-20.—Positioning the vacuum feet.

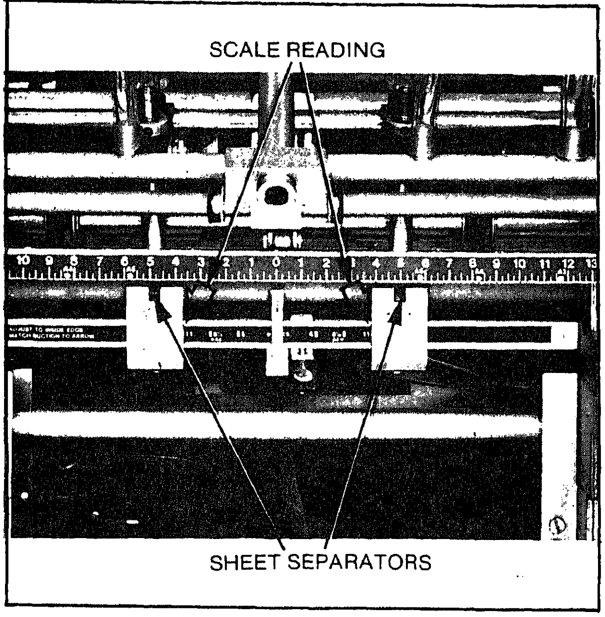

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Figure 12-21.—Positioning the sheet separators.

directed to the stack is controlled by the blower control knob.

You should check the sheets at the start of the run to see if they are feeding properly, and then adjust the blast, if necessary, while the press is in operation. Turning the blower control knob clockwise decreases the blast, and vice versa.

The vacuum feet, shown in figure 12-20, should be spaced evenly along the front edge of the stock. You can loosen the setscrews on the vacuum feet and move them sidewise as necessary.

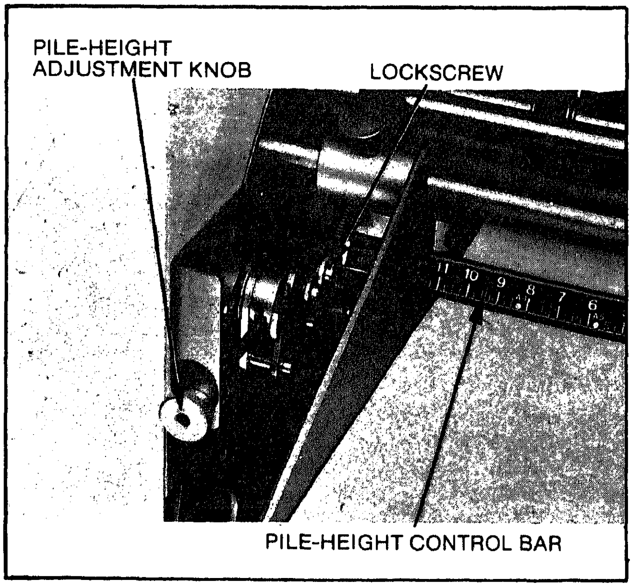
If the vacuum feet fail to pick up the top sheet or if they pick up two or more sheets at a time, you can adjust the suction with the vacuum control at the start of the run. In general, you should use less vacuum for thin stocks and more vacuum when you are running heavy stocks. To close off the suction on one of the vacuum feet entirely when you are running small-sized stock and only one vacuum foot is necessary, you should push its vacuum shutoff button.

Separator Fingers

Two small metal fingers, called sheet separator (fingers) as shown in figure 12-21, ride the edge of the paper stock just enough to prevent the vacuum feet from picking up two or more sheets at a time from the stack. The tip of the separator fingers ordinarily overlaps the leading edge of the stock by about three-sixteenths inch. However, you may set them for maximum extension when you are running thin stock or remove it entirely when you are running heavy cardboard stock. You should position the sheet separator fingers directly below the two sucker feet. Loosen the thumbscrew at the bottom of the separator finger brackets when it is necessary to reposition the fingers.

Pile Height Control

When the press is in operation, you can change the height of the stack of paper stock by turning the pile-height adjustment knob (fig. 12-22).



57.400X
Figure 12-22.—Adjustments for pile height.

Although it will seldom be necessary, you can change the speed of elevation of the feed table holding the paper stock by loosening the lock screw and moving the pile-height control bar toward or away from the sucker feet. (Note: There are two screws holding the bar, one on each side.) Moving the bar toward the vacuum feet causes the paper stack to rise slower, and vice versa. For the average run of work, most operators leave this bar set about 1 1/2 inches from the vacuum feet when the feet are all the way down.

On the Multilith model 1360, the pile height link assembly may become stretched and need to be replaced with a heavier link assembly after running 11- by 17-inch stock at full-load capacity.

Adjusting the Double-Sheet Detector

The sheet separator fingers prevent more than one sheet at a time from being fed into the press. However, the vacuum feet may still pick up two sheets occasionally if the paper sticks together or if the suction or blast is incorrectly adjusted. For this reason, the Multilith 1330 or 1360 is equipped with a device known as the double-sheet detector, or caliper. See figure 12-23. This device automatically deflects or throws out the sheets if two or more are fed through the area of the detector. These deflected sheets fall into a metal tray located just below the register board.

When you are setting the caliper, lower the feed table so that no stock will feed through; then turn on the press motor and the vacuum pump switch. Next, fold a piece of paper so that you have a double thickness at one end and a single thickness at the other. Work this paper back and forth under the detector roller and adjust the knurled raise/lower knob until the single thickness slides under the roller freely, while the folded end (double thickness) of the paper trips the deflector mechanism.

You can move the double-sheet detector sidewise by loosening the lock screw and sliding the detector along the rod to which it is attached. The double-sheet detector is generally centered between the sucker feet, but you should not set it so close to them that it will interfere with their operation.

Pullout Wheels

The pullout wheels, shown in figure 12-24, pull the top sheet off the stack as it is lifted by the vacuum feet and force that sheet over a lower roller and onto the moving conveyor tapes, which carry it down the register board. These pullout wheels are adjusted sideways to accommodate different widths of paper stock by sliding the wheels into position above the scale that shows the width of the sheet to be run. You should set

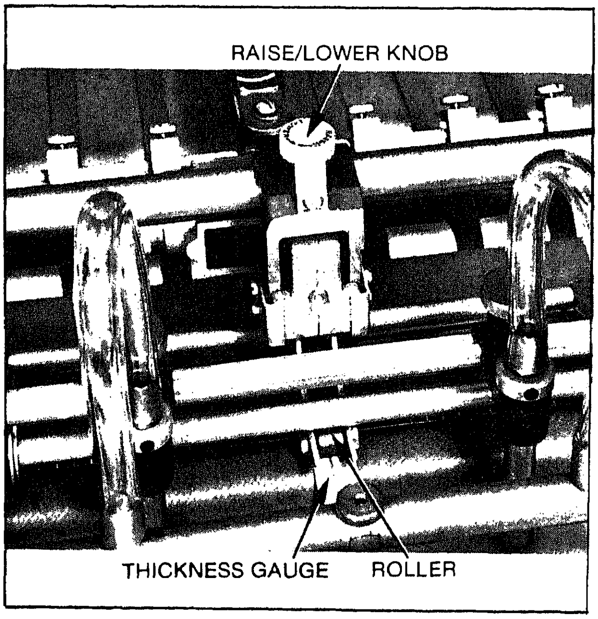


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Figure 12-23.—The double-sheet detector.

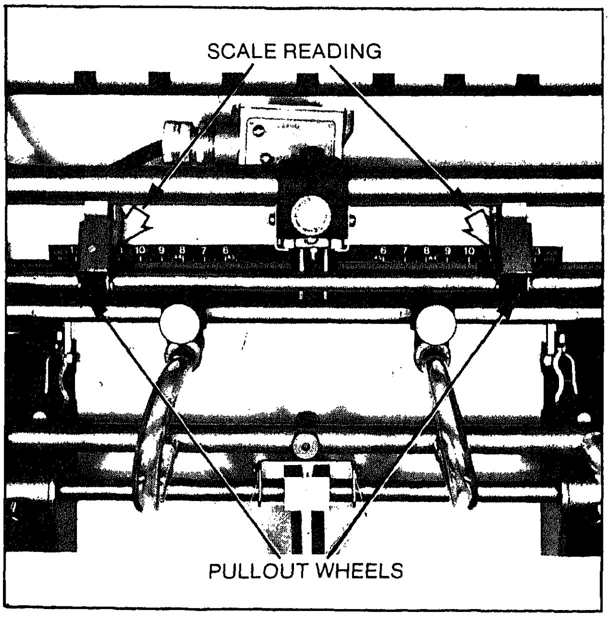

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Figure 12-24.—The pullout wheels.

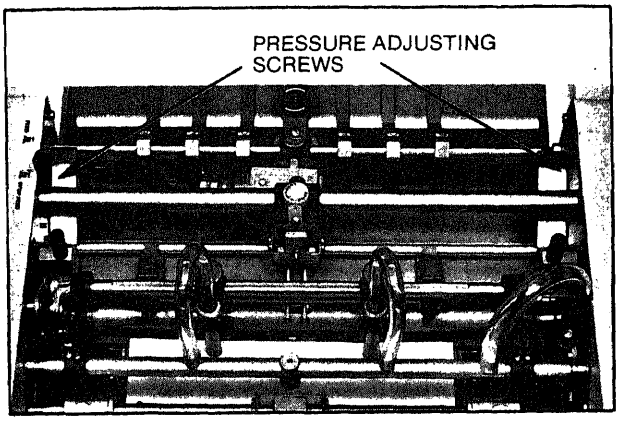

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Figure 12-25.—Pullout wheel pressure adjustment.

each roller halfway between one vacuum foot and the edge of the paper.

The tension on these pullout wheels is controlled by an adjusting screw at each end of the wheel shaft. If there is more pressure on one side than on the other, the sheets will feed onto the register board crooked, and you must reset the wheel tension with the adjusting screws. (See fig. 12-25.) Turn the adjusting screw (on the side affected) in a clockwise direction to reduce the tension of the pullout wheel, and vice versa. Tightening the wheels (increasing the tension) increases the speed of the papers travel, of course.

Sheet Controls

There are seven sheet (conveyor) tapes (see fig. 12-26), which carry the paper down the register

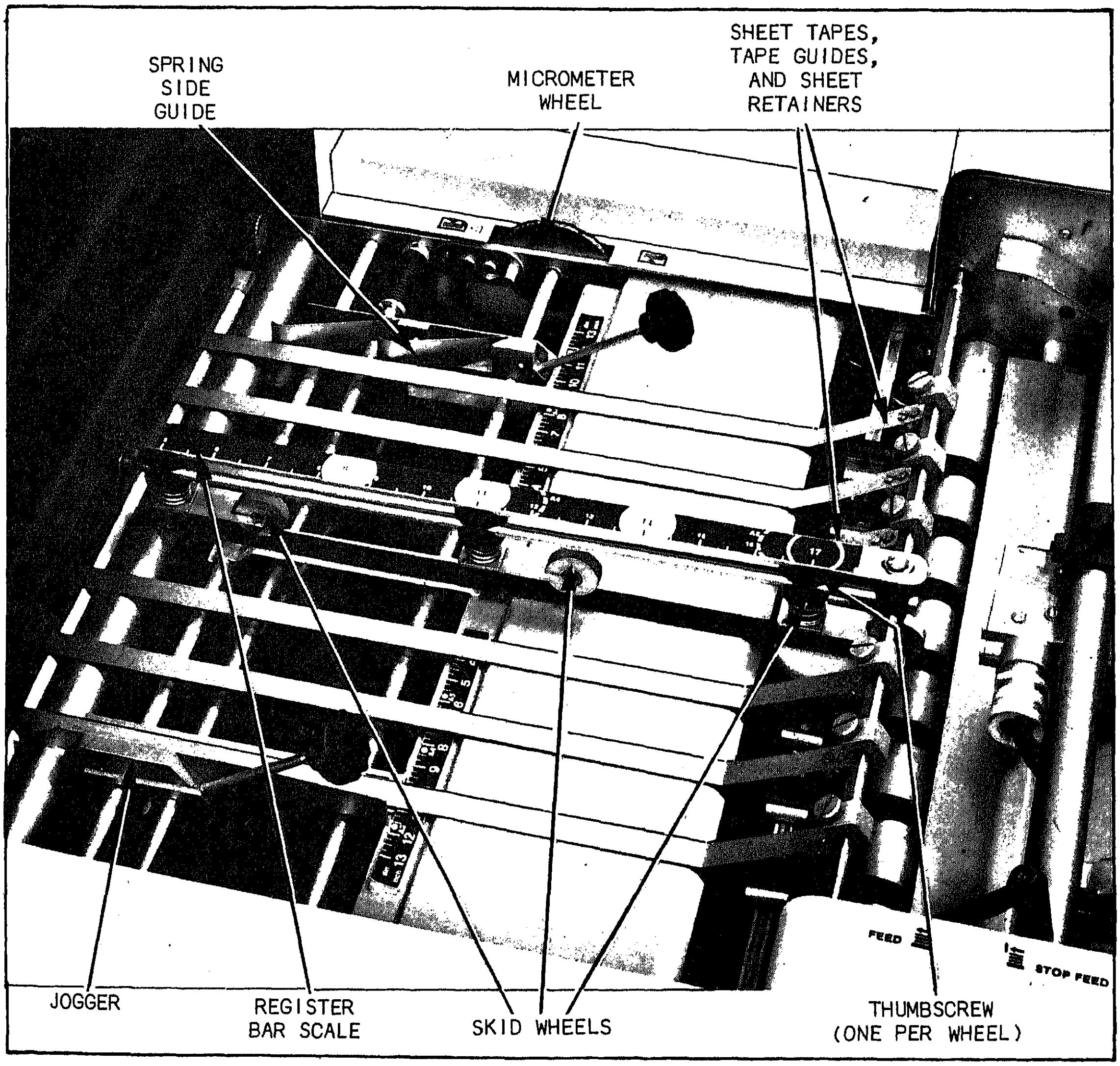

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Figure 12-26.—Parts location for register-board setup procedures.

board, that are also adjustable sidewise to accommodate different widths of paper stock. To move the tapes, you must push the tape guides from under the register board to the left or right. Always set the outer tapes near the right side guide and left jogger and space the other tapes evenly between these outer tapes.

Six metal strips, known as sheet retainers, are used to control the sheet of paper as it is carried down the register board towards the printing unit. These sheet retainers, shown in figure 12-26, should be positioned over all but the center sheet conveyor tape.

In addition to the sheet retainers, the presses are equipped with the three removable skid wheels attached to the register bar scale (fig. 12-26). These wheels provide greater sheet control when short, heavy stock is being run. The pressure placed on the paper by these wheels is adjustable by turning a thumbscrew above the wheel. Most press operators position the skid wheels so that they are just off the tail end of the paper when the sheet is resting against the stop fingers (located just in front of the printing unit). This placement of the skid wheel prevents the sheet from bouncing away as it strikes the stop fingers and makes for better registration. As discussed earlier, the registration of the paper from left to right can be adjusted with the micrometer wheel.

Stop Fingers

As the paper reaches the end of the conveyor tapes of the register board, it is stopped momentarily by a set of pins (stop fingers). The left side guide then pushes the sheet sidewise so that it is properly positioned (registered) to enter the printing unit.

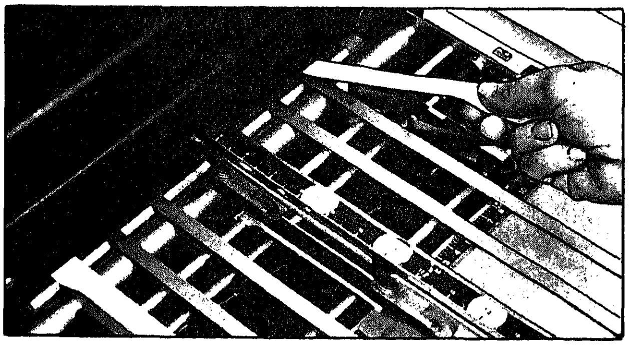

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Figure 12-27.—Checking feed-roller pressure.

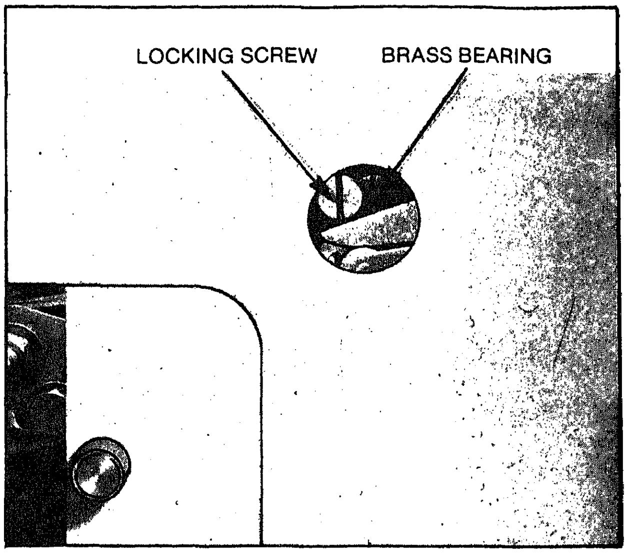

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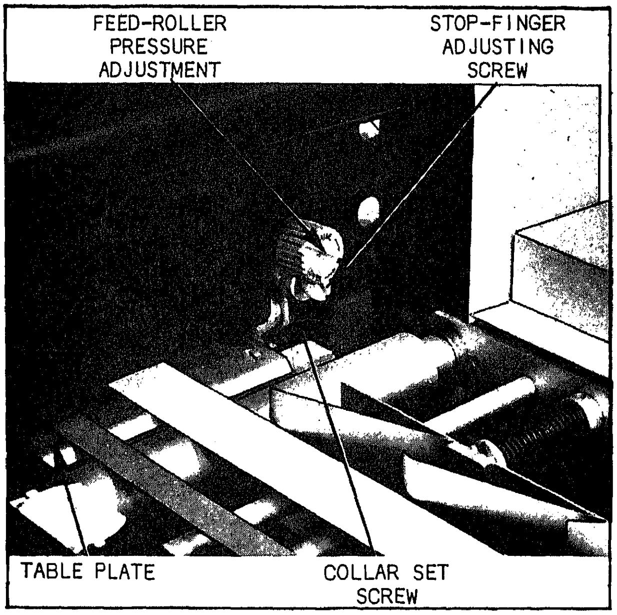
Figure 12-28.—Feed-roller leveling adjustments.

A moment later, the stop fingers recede (drop down) to clear the leading edge of the paper, and a metal feed roller lowers against the sheet to forward it into the gripper fingers on the impression cylinder.

The stop fingers and feed rollers seldom need adjusting, but if the stock feeds into the grippers crooked, you should check to see if the pressure is even at both ends of the feed roller and that the stop fingers are properly adjusted (see figs. 12-27, 12-28, and 12-29). You can test the pressure by inserting two strips of 20-pound bond paper between the upper and lower feed rollers and rotating the press using the handwheel until the upper roller drops down against the strips. Then try to withdraw the paper. There should be a firm, even pull on both strips, but not so great that the paper will tear.

If one strip is held tighter than the other, loosen the locking screw (fig. 12-28) and turn the brass (eccentric) bearing counterclockwise to increase the tension on the near end of the lower feed roller or clockwise to decrease it. In order to make this adjustment, it may be necessary to reduce the overall tension on the rollers. To reduce the overall tension, turn the feed-roller pressure adjustment (screw) in a clockwise direction (fig. 12-29). Reverse this operation to increase the overall tension of the feed roller.



57.407X

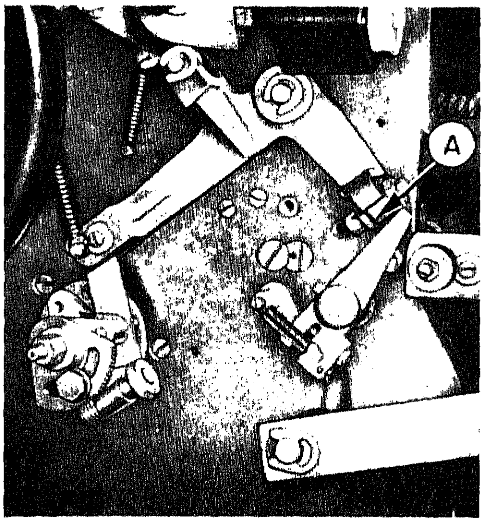
Figure 12-29.—Feed-roller pressure and stop-finger adjustment.

The stop fingers will seldom need adjustment. However, if they start to nick the paper as it is fed into the printing unit, it is an indication that they are not dropping far enough to clear the edge of the sheet. In this case, you can lower them slightly by loosening the collar setscrew and turning the adjusting screw clockwise. (See fig. 12-29.) Always retighten setscrews after adjustments have been made.

Control Lever and Sheet Detector

Before you can begin printing, you must place the single-control lever in the print position. This lever brings the dampener and ink form rollers in contact with the plate, and it also brings the plate cylinder in contact with the blanket cylinder.

The contact between the blanket cylinder and the impression cylinder (impression) is automatically controlled by a small metal finger located at the end of the register board, just in front of the printing unit. When a sheet is fed into the printing unit of the press, it trips this detector finger to actuate the detent pawl, shown in figure 12-30, and puts the press on impression. The impression remains off when no sheets are feeding through. You can put the press on impression manually by pushing the detect pawl toward the delivery end of the press and holding it there while you rotate the machine using the handwheel.



A. DETENT PAWL

57.750X

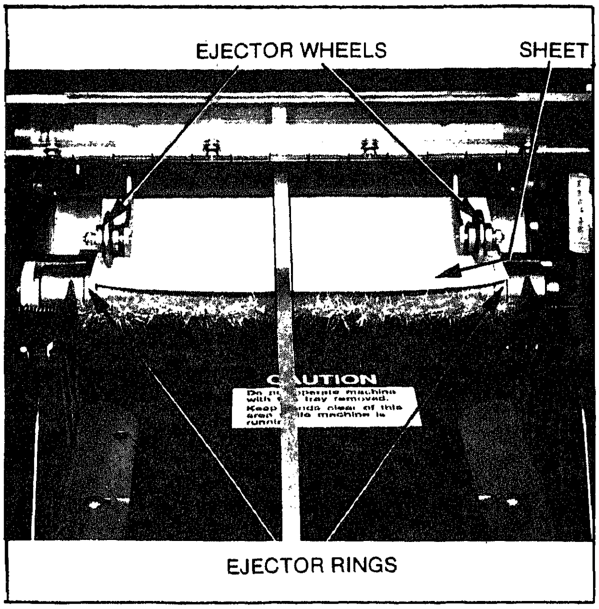
Figure 12-30.—Detent pawl. After you remove the side plate on the operator's side of the press, the detent pawl is then accessible. The detent pawl causes the blanket and impression cylinders to come in contact with each other either automatically or manually.

AUTOMATIC COUNTER

The detent pawl also actuates the sheet counter. When the machine is in operation, the numbers on the counter change automatically with each impression so that you have a running record of the number of impressions made. At the beginning of a run, you should set the counter to 00000 by turning its notched wheel until the five zeros appear in the window of the counter.

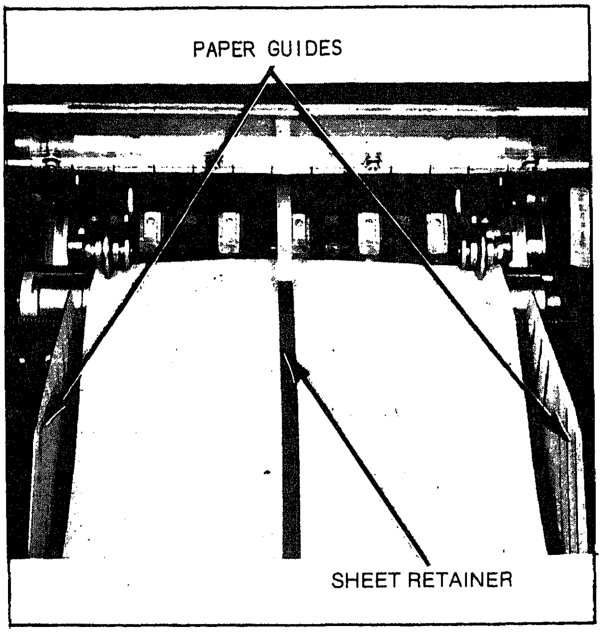
EJECTOR UNIT

On models without the chain delivery unit, the sheets are ejected from the impression cylinder grippers and passed through a set of



57.408X

Figure 12-31.—Standard paper ejector with leading edge of sheet just emerging from nip between ejector wheels and ejector rings.



57.409X

Figure 12-32.—Standard paper ejector with sheet about to drop into paper receiver.

ejector wheels and rings, into a paper receiver (tray) (fig. 12-31).

A piece of tinsel is stretched across the delivery end of the press. This tinsel is used to remove static electricity from the paper. You should keep a supply of tinsel on hand and change it as it becomes worn or dirty.

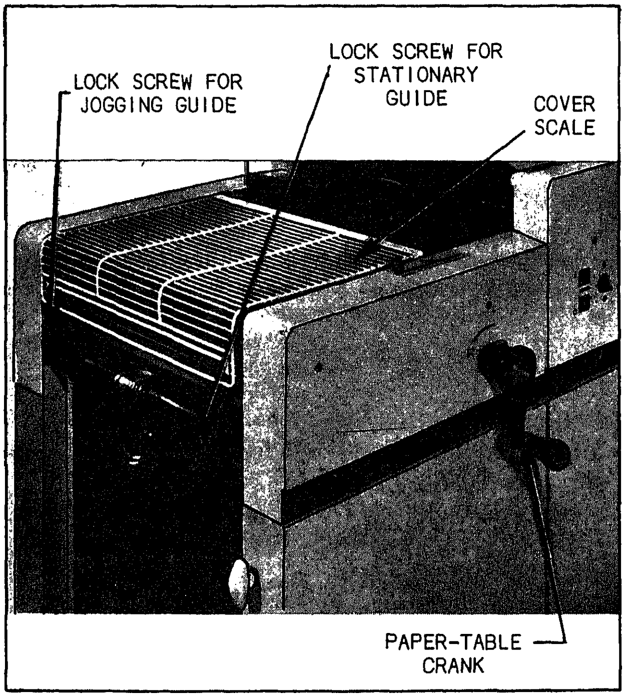
The ejector wheels of the ejector unit are adjustable sidewise and are generally set along the outside (non-image) edges of the press sheet, since the ejector wheels are liable to smear the wet ink if they pass over the printed areas. The ejector rings, shown in figure 12-31, are also adjustable sidewise. You should position them inside the ejector wheels if the stock tends to curl up at the edges; position them outside the wheels if the stock curls down. To set the paper receiver, shown in figure 12-32, you should run (jog) a sheet through the press, stopping it just before the sheet is completely ejected into the paper receiver. Then position the paper guides so that they will just clear the sides of the sheet when it is released. The back guide may be set in any position that will allow the sheet to clear the ejector wheels and rings before it is deposited in the paper receiver. The long metal strip in the center of figure 12-32 is known as the sheet retainer. It directs the sheets into the paper receiver after it is ejected.

CHAIN DELIVERY UNIT

A receding paper table is attached to the automatic chain deliver unit on some Multilith presses (fig. 12-33). This unit consists of three gripper bars spaced on a chain system, a receding paper table with a crank for manual lowering and raising, and automatic paper joggers.

The gripper bars of the chain delivery unit pick up the press sheets from the impression cylinder and move them to the receding paper table. The receding paper table is set to recede (lower) at intervals to allow more press sheets to accumulate on the paper table than in the conventional paper receiver. The automatic paper joggers move as the press is running, keeping the pile of press sheets in a neat stack.

The entire unit is covered with a wire safety screen to protect the operator from injury during press operation. The safety screen is interlocked to the electrical system of the press which prevents



57.410X

Figure 12-33.—The chain delivery unit.

the press from running when the screen is up when adjustments are being made to the unit. Do not attempt to override this safety feature—it is installed for your protection.

PRESS ADJUSTMENTS

There is no necessity for constant, fussy adjustments on any offset press. The cams and parts that regulate the timing and registration are precision built and factory set, and you should not disturb them unless you are absolutely sure that a defective mechanical condition exists. Ordinarily, you will find that most press difficulties are caused by worn blankets, incorrect ink distribution, improper balance between ink and water, a poor plate, excessive pressure on ink or dampening rollers, or humidity.

When press adjustments are necessary, they should be made by a person who is completely familiar with the press. The following paragraphs will describe most of the major adjustments on these presses, but remember that if the press is operating properly, you should leave it alone. Tampering with a press that is working well will eventually ruin your press.

Adjusting Ink Form Rollers

The Multilith 1330 and 1360 offset presses are equipped with three ink form rollers. The rollers contact the plate and distribute ink to it. If these rollers are not parallel to the plate, the ink distribution will be uneven. You can check the form roller-to-plate pressure by inking the press and then with the press stopped lower the ink form rollers into contact with a dry plate on the plate cylinder (fig. 12-34). If the rollers are correctly adjusted, they will leave an even, narrow stripe with a width as follows:

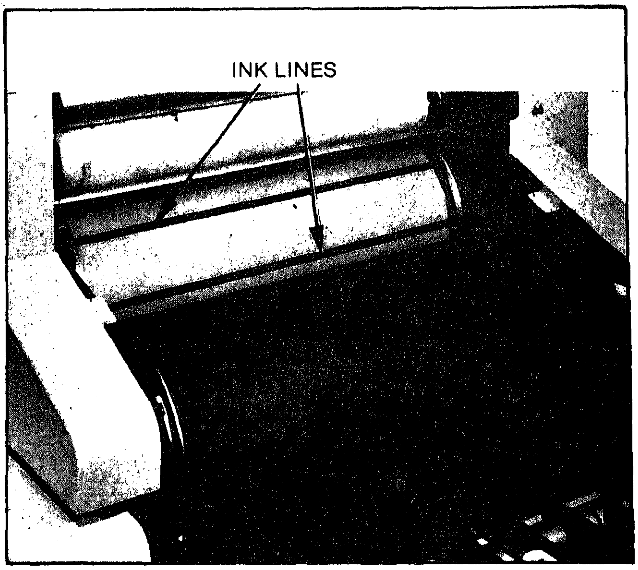
Upper form roller—one-eighth inch wide

Middle form roller—five thirty-seconds inch wide

Bottom form roller—five thirty-seconds inch to three-sixteenths inch wide

If either form roller produces a strip with a width other than those mentioned, it must be adjusted.

To adjust the overall pressure of the form rollers, you should loosen the setscrew on the



57.411X

Figure 12-34.—Ink lines impressed upon plate by ink form roller during check of form roller-to-plate pressure.

end of that knob with a screwdriver. Turning the eccentric shaft counterclockwise increases the overall roller pressure; clockwise decreases the pressure.

NOTE

The setscrew requires a bristo wrench, which is somewhat different from a common allen wrench. Those wrenches are included in a tool kit which is supplied with each press when it is purchased. The correct wrench must be used. Otherwise, the setscrew will become stripped and you will be unable to loosen it. Make sure that you retighten the setscrew after adjusting the roller.

To parallel the ink form rollers, you should set the night-latch knob to the vertical position and remove it and the far side plate from the press.

The eccentric bearing you have exposed raises or lowers the far side of the form roller. Notice that each roller has an eccentric bearing. Loosen its setscrew and turn the bearing clockwise to raise the right (far) side of the roller. Turn the bearing counterclockwise to lower the right side of the roller. Retighten the setscrew after adjusting the eccentric bearing to lock your setting in place.

You will have to check the overall pressure of the rollers after making this adjustment because the paralleling adjustment may change the overall pressure setting. Follow the procedure described at the beginning of this section to make the check. Then, if necessary, reset the overall pressure.

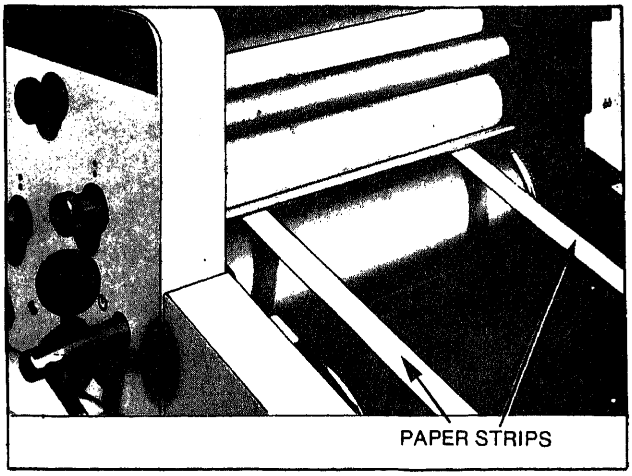
A third adjustment that must be made to the form rollers is to eliminate roller end play. End play causes ink streaks on the plate. To relieve the streaks, you must put the night-latch knob in the vertical position. Then remove the night-latch knob from its shaft. Next remove the far side plate under the knob from that side of the press. Then, loosen the setscrew of each form roller in turn and press the eccentric bearing in as far as it will go. After you make this adjustment, the roller will rotate freely on its shaft. Retighten the setscrew and replace the press side plate and the night-latch knob before operating the press.

You can parallel the moisture form roller with the plate by using a method similar to that just described for paralleling the ink form rollers. Drop the moisture form roller against the plate on two strips of bond paper. (See fig. 12-35.) Then check the pressure on the strips by pulling on each strip. If the pull is uneven, loosen the setscrew of the uneven roller end and turn its eccentric bearing clockwise to reduce the pressure on the near side of the roller or counterclockwise to increase it. To increase the overall pressure, you should loosen the setscrew and then insert a screwdriver in the end of the shaft (fig. 12-36). Then turn the screwdriver counterclockwise. A clockwise turn of the shaft will reduce the overall pressure.

If the moisture form roller develops end play, lift the roller from the plate and remove the idler roller. Then loosen the moisture form roller setscrew and push in on the eccentric bearing until the end play is removed. Retighten the setscrew to hold the eccentric bearing in position.

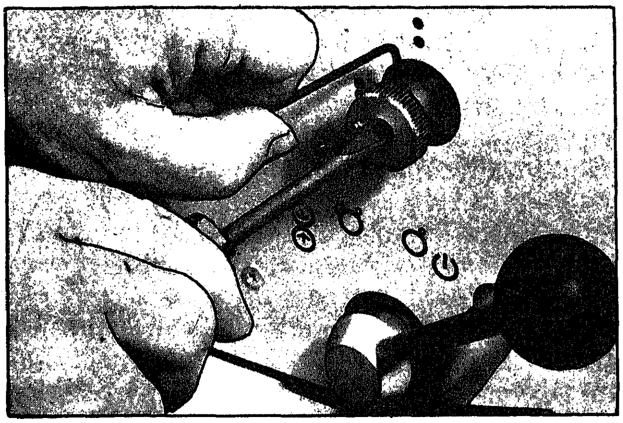
Adjusting Blanket-to-Plate Pressure

You can check the pressure between the plate and blanket cylinders by a method similar to that used for checking the form roller pressure. Put an old plate on the press and run it with only the ink form rollers in contact with the plate until it is inked solid. Then raise the ink form rollers, stop the press, and turn the handwheel until the plate



57.412X

Figure 12-35.—Checking pressure of moisture form roller.



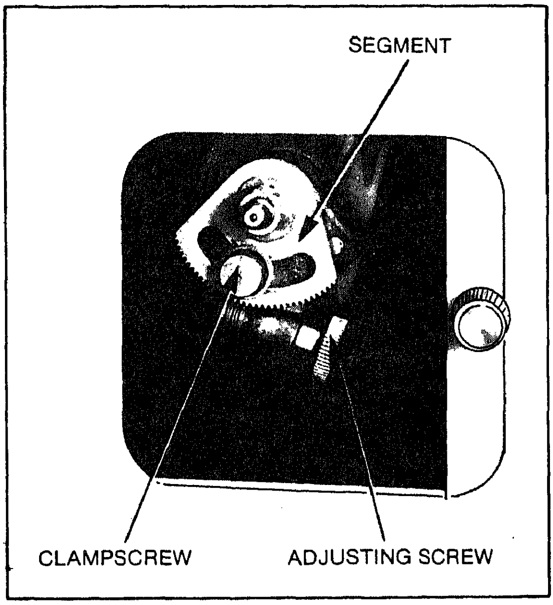
57.413X
Figure 12-36.—Adjusting overall pressure on moisture form roller.

is centered over the blanket. Next, bring the plate cylinder into contact with the blanket by placing the single-lever control in the print position. Return the lever to the off position immediately to break contact between the cylinders; turn the handwheel until the inked line on the blanket cylinder is facing you. If the cylinder pressure is correct, the inked line should be one-eighth inch to five-sixteenths inch wide.

To adjust the pressure between the blanket and the plate cylinders, you should loosen the locking bolt in the opening below and to the right of the single-lever control. Move the single-lever control to your left (towards its print position) to increase the pressure, or to your right (towards its off position) to decrease pressure. This adjustment normally requires very little movement of the single-lever control in the required direction. Therefore, press operators generally just tap the single-lever control with their hand when adjusting the blanket-to-plate pressure. After you complete the adjustment, retighten the locking bolt, and return the single-lever control to the off position. Before you run the press, recheck the blanket-to-plate pressure using the method described at the beginning of this section.

Adjusting Impression Cylinders

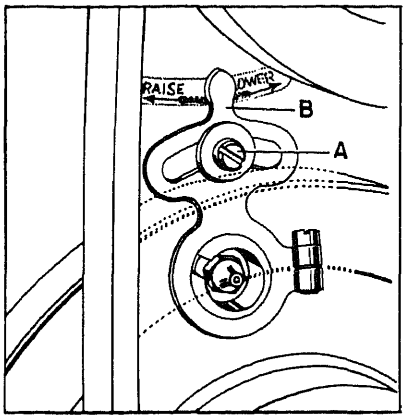
Occasionally, it is necessary to change the pressure between the impression cylinder and the blanket to accommodate different thicknesses (weights) of paper stock. You can do this by loosening the clamp screw and turning the adjusting screw (fig. 12-37). You can reach these screws through the covered opening on the near (operating) side of the press just below the handwheel.



57.414X
Figure 12-37.—Pressure adjustments for standard impression-cylinder device.

In making this adjustment, you should loosen the clamp screw and back off the adjusting screw one or two turns. Next turn the press by hand to move one of the paper stock sheets to be run between the blanket and impression cylinders. Then turn the adjusting screw counterclockwise until it is snug. Give it another quarter turn to obtain the required printing pressure "squeeze." By turning this adjusting screw, both the segment and the impression cylinder will move, causing the printing (impression) pressures to change. After the adjustment is made, you should then retighten the clamp screw.

Some models of the press are equipped with a sheet-thickness compensation device that automatically adjusts to various thicknesses or weights of paper. If the press you are operating is equipped with this device, check the operator's manual or get help from an experienced operator before making any adjustments to it.



A. LOCK SCREW
B. POINTER

57.270X

Figure 12-38.—Leveling sector for paralleling impression cylinder and blanket cylinder.

Leveling the Cylinder

If the printed sheet is light in ink color on one side and all other press adjustments are correct, it may be necessary for you to parallel the impression cylinder with the blanket cylinder, although such an adjustment is rarely necessary.

The diagram in figure 12-38 shows the leveling sector where the impression and blanket cylinder are paralleled. You can see it through an opening in the casement on the far side of the press under the register board side plate. However, it is necessary to remove the press side covering plate on the far side of the register board side plate. Then you can slip a screwdriver through the opening in the press casement and loosen the lock screw (fig. 12-38). Then move the pointer in the direction marked Raise or Lower to increase or decrease the printing (impression) pressure on the far side of the cylinder. Retighten the lock screw after the adjustment is completed.

MAINTENANCE

The life of your press depends on the care it receives. Proper lubrication and maintenance are two of the most important aspects of your job.

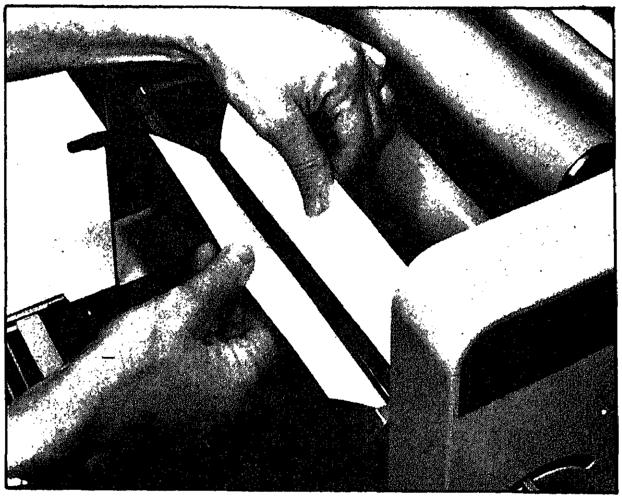
Daily Care Is the Best Policy

It is best to oil the press according to the diagrams furnished by its manufacturer, but if such diagrams are not available, you can tell which parts need oiling by watching the press in operation. In general, you should oil any place where one moving part touches another part. You will find that if you mark the place with red paint, it will be easier for you to find it for subsequent oilings. However, the oiling and marking procedure should never be done while the press is operating. Watch carefully for hidden oil holes, as they are easily overlooked. You will find many of these in the feeder, particularly in the elevating mechanism and the push bar which operates the side guides.

Always begin at the same place on the press and as you oil, work all the way around the press. Wipe off excess oil with a rag; don't allow it to dry or run down the side of the machine.

You should oil all oil holes every day. Fill the oil reservoirs on the vacuum pump daily or as required. Oil all moving parts where they touch another moving part with a drop of oil once a day.

Grease-packed needle or ball bearings should be repacked with grease at regular intervals as outlined in the operator's manual for your press. Put grease on all chains and gears once a week.



57.415X

Figure 12-39.—Wedging ink out of ink fountain.

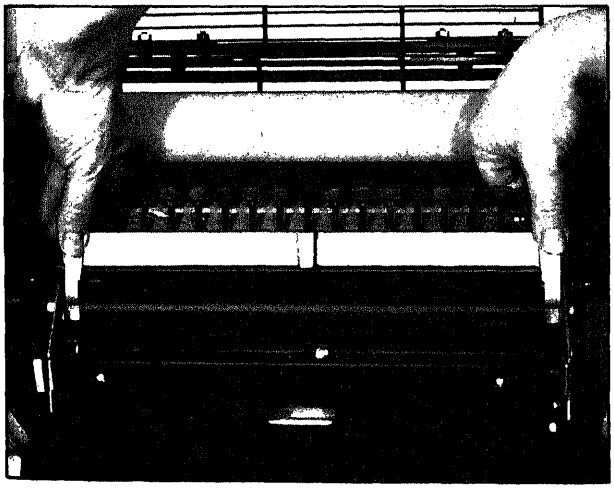
Grease bearings on the form rollers once each week.

Cleaning the Ink Fountain and Rollers

At the end of the day, you should remove as much ink as possible from the ink fountain. You can wedge the ink out by cutting two strips of card stock about 3 1/2 inches by 12 inches and inserting them into the ink fountain as far as you can using the procedure shown in figure 12-39. Then lift out the strips and the ink collected between them and discard. Next, remove the ink fountain by rotating and lifting it. This separates the two end brackets from the bearings. See figure 12-40.

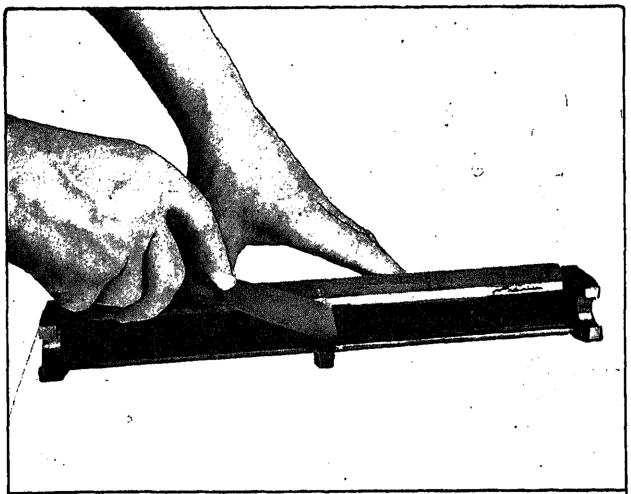
You can scrape even more ink from the fountain after it has been removed from the press by using an ink knife and the method shown at the top of figure 12-41. To finish cleaning the ink fountain, you may use cotton pads or rags moistened with solvent in the manner shown at the bottom of figure 12-41. After you have cleaned the ink fountain with a solvent, you should wipe the fountain dry and set it aside while you clean the ink rollers.

To facilitate the cleaning of the fountain, many press operators place a fountain liner (a sheet of adhesive-backed paper cut to the proper shape) in the fountain before they put ink into it. This liner can be removed and thrown away when the press is cleaned up (washed up), and a new liner can be inserted before ink is placed in the fountain again.

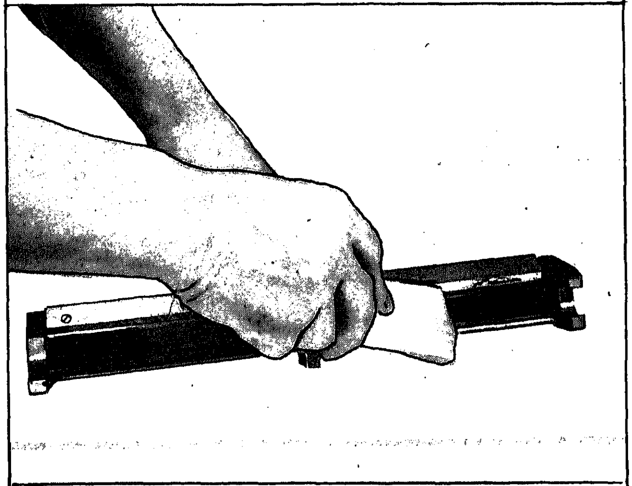


57.416X

Figure 12-40.—Removing the ink fountain.



CLEANING INK FOUNTAIN WITH INK KNIFE.

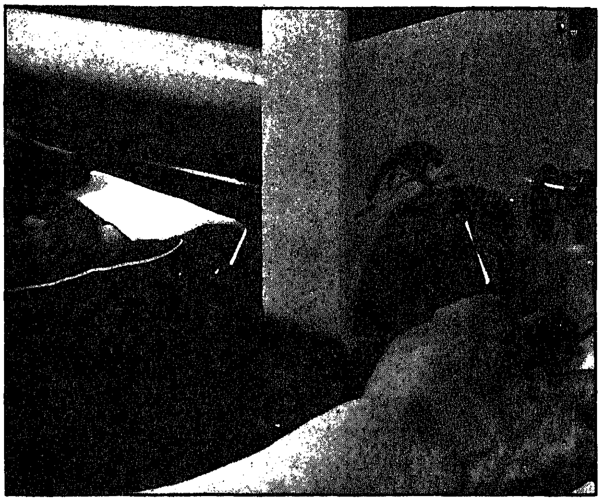


FINISH-CLEANING THE INK FOUNTAIN.

57.417X

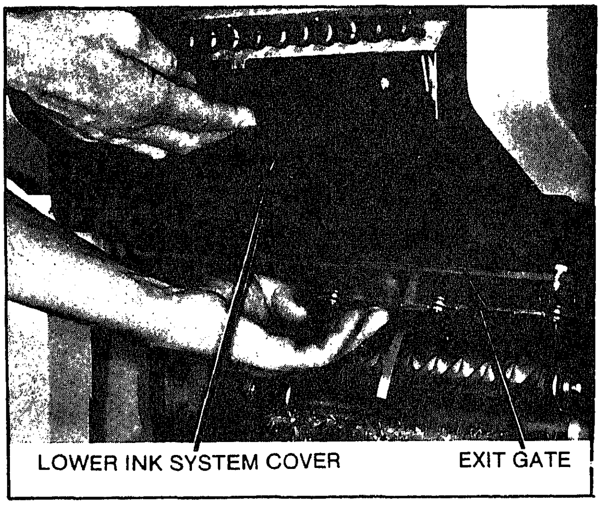
Figure 12-41.—Steps in cleaning the ink fountain.

After you have cleaned the fountain, you should clean the ink roller system. To protect the moisture system from contamination during ink system cleanup, you should remove the moisture system rollers. To start the cleanup procedure for the ink roller system, you should first make sure that the ink form roller knobs and the ink ductor lever are in the on position and that the press night-latch knob is in the horizontal position.



57.418X

Figure 12-42.—Cleaning the ink-fountain roller.



57.419X

Figure 12-43.—Removing the lower ink system cover and exit gate assembly.

Next, you should clean the ink-fountain roller. As you can see in figure 12-42, a rag or cotton pad moistened with solvent is held against the roller as you rotate it with the ink fountain roller crank. After you remove the ink, use a clean, dry rag or cotton pad to dry the roller as you continue to rotate it.

To clean the rest of the ink roller system, some press operators use the "cleaner sheet" method. This method consists of using a blotterlike paper stock that clamps onto the plate cylinder in the same manner as a plate does.

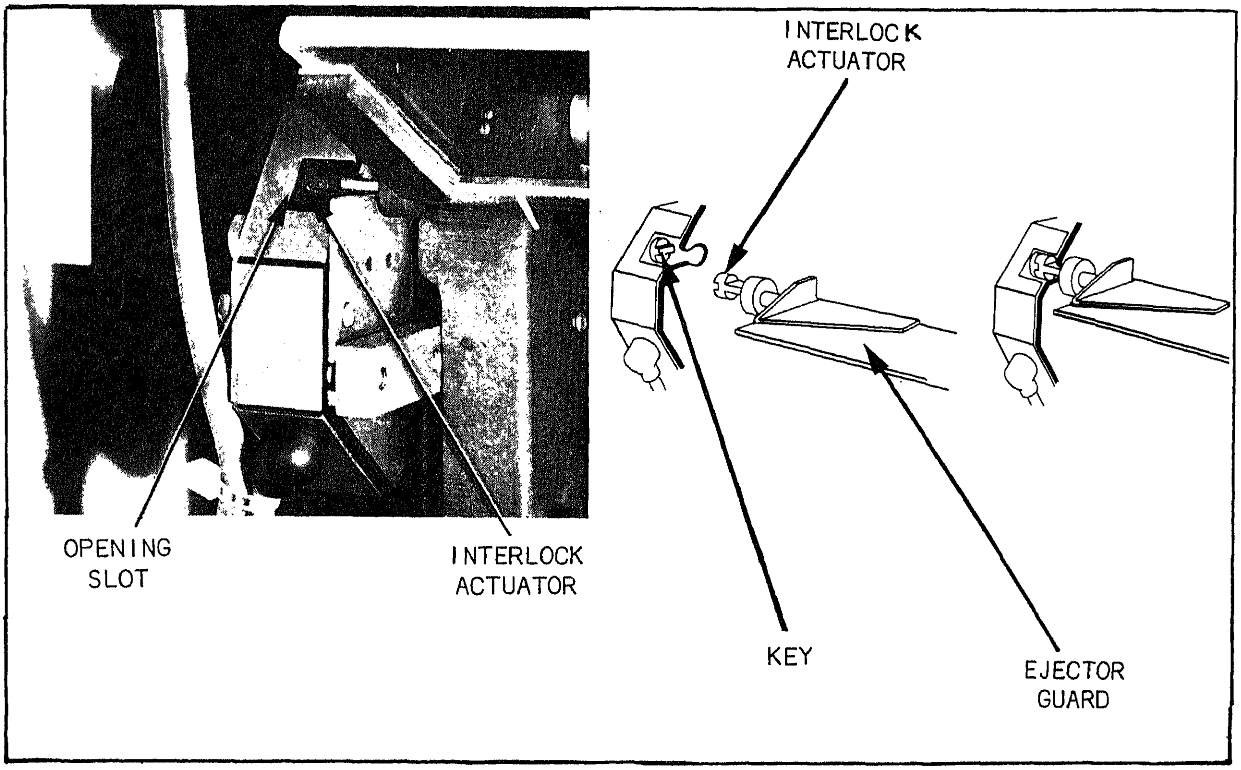
Once you position the cleaner sheet in place, remove the lower ink system cover for the ink system. See figure 12-43. The first step in removing the cover is to lift the exit gate into the up position to unlatch the lower ink system cover. Now, carefully pull the cover straight out towards you. Lay a cleaner sheet inside the cover to protect everything under it from ink and solvent which might splash there during cleanup.

To reinstall the lower ink system cover, you should guide the interlock actuator into the opening slots until the cover snaps into place (fig. 12-44). Once this is done, you have seated the key and interlock actuator in the opening slot. With the key and actuator on the cover seated in the opening slot, you must then swing the exist gate back down into the safeguard position before the press can be run. This key and interlock actuator serve as a safety switch. When they are not seated together, the press will not operate.

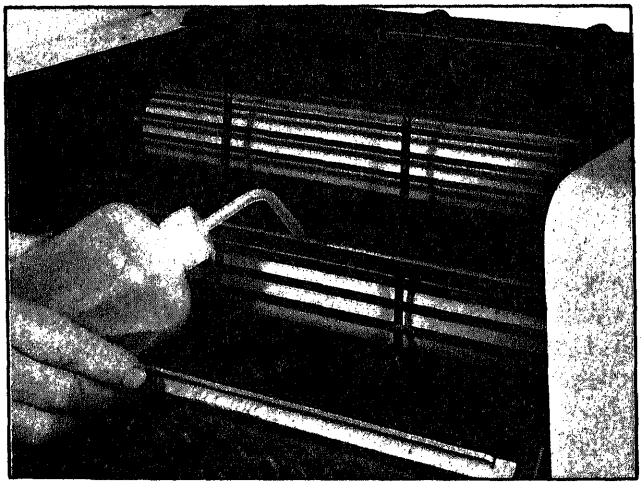
Next, you should start the press operating and run it at a reduced speed while applying a small amount of solvent across the ink rollers through the slots in the ink roller cover, as shown in figure 12-45. Allow the press to run about 30 seconds to give the solvent time to break down the ink on the rollers. Then move the single-lever control to the ink position, which moves the ink form rollers into contact with the cleaner sheet on the plate cylinder. As the press rotates, the cleaner sheet will absorb the ink and solvent from the ink form rollers. When you see that the cleaner sheet has become saturated with solvent and ink, move the single-lever control to the off position. Stop the press and replace that sheet with a clean one. Restart the press, add solvent and again move the single-lever control to the ink position. Continue to replace the saturated cleaner sheets with clean ones until a sheet no longer picks up ink. When this happens, move the single-lever control to the off position and stop the press.

Now, you may remove the cleaner sheet from the lower ink system cover. You should also wipe up any ink and/or solvent you might see on or around this cover while it is removed from the press. Move the ink form roller control knobs to their off position and move the press night-latch knob to the vertical position.

After prolonged use, the ink rollers may become glazed with dried ink. You can remove this glaze from the rollers by soaking them in a



57.420X
Figure 12-44.—Actuator alignment for reinstallation of lower ink system cover and exit gate assembly.



57.421X
Figure 12-45.—Applying Blankrola Solvent to the ink system through slot in cover.

solution of lye water and then rubbing them down with pumice powder and a solvent.

If you don't have cleaner sheets, there are other methods you may use to clean ink roller systems. Some press operators remove the ink rollers that can be removed from the press, and clean them by hand. This cleaning method is done by taking the rollers out one at a time, and rubbing them with a rag or cotton pad moistened with a solvent. After you have removed and cleaned all these rollers, you can rotate the rollers still in the press by turning the handwheel. As you turn the handwheel, hold a rag or cotton pad moistened with a solvent in contact with each roller until they are all free of ink. Don't forget to also dry all the rollers with a dry rag or cotton pad after you have cleaned all the rollers.

Other operators have their presses equipped with an ink roller cleanup device. This press attachment replaces the conventional cleaner sheet method of cleaning the ink roller system and greatly speeds up the cleaning process. If your press is equipped with such a cleanup device, you should consult the manufacturer operator's manual before operating or making any adjustments to it.

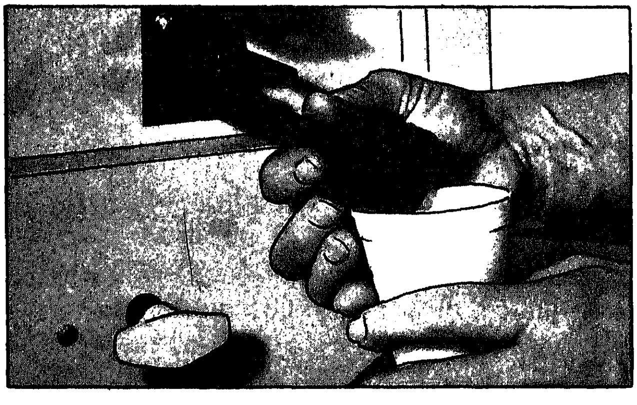
Cleaning the Moisture Rollers

You should drain the moisture fountain at the end of each day (fig. 12-46). If the metal moisture fountain roller or oscillator roller becomes contaminated with ink, clean them with pumice powder and water. Then rinse them with water and coat them with a desensitizing etch or fountain solution. After these coatings dry on the roller, they will protect it from contamination and make it easier to clean the next time.

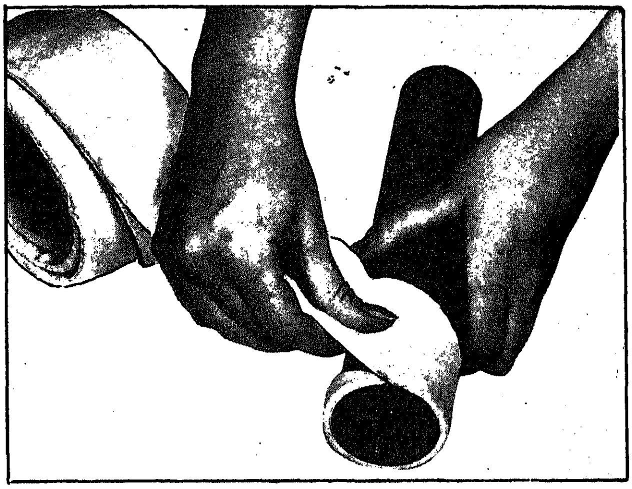
You can clean molleton-covered moisture rollers by scrubbing them with water. If they are extremely dirty, you should take them out of the press and clean them by scrubbing them with solvent and water or with a good detergent.

Saturate the molleton-covered moisture roller with water so that the cleaner will not soak into their covers; then scrub the rollers with a stiff brush, in solvent and water or a detergent solution. The roller must be rinsed very well in warm water and allowed to dry completely. If there is a lot of ink on the surface of the molleton covering, you should scrape the molleton with a metal blade before applying the cleaning solution and scrubbing.

You should change molleton covers when they get too dirty to do their work effectively even after cleaning. First remove the moisture ductor and form roller and peel off the dirty molleton cover. After you peel the paper backing from the adhesive of the clean covering, wind it around the rubber roller as shown in figure 12-47. You can start wrapping at either end. The molleton cover is cut by the manufacturer to a shape that is designed to fit the shape of either the ductor or the form roller in the moisture system.



57.422X
Figure 12-46.—Draining the moisture fountain.



57.423X
Figure 12-47.—Winding a molleton cover onto a roller.

When you put the molleton-covered rollers back into the press, they must be smoothed out by running them on the press. This process is referred to as rolling-in. To roll-in the coverings, you should first wet the roller coverings with tap water, then install them in the press. Next, turn on the press, and spin the fountain roller as the ductor roller contacts it to transfer the fountain solution. When the roller covers are wet, stop the press and put a clean cleaner sheet on the plate cylinder and start the press. With the press running, move the single-lever control to the moist position. After a minute or so of running the press, you will need to start spinning the fountain roller control knob every once in awhile as the ductor roller contacts the fountain roller to keep the rollers wet, as the cleaner sheet will be absorbing the moisture from the moisture system.

As a cleaner sheet becomes soaked, you should stop the press and replace it with a dry one. You should repeat this procedure through three cleaner sheets. However, a total of four sheets should be used. The purpose of the fourth sheet is to pack the moistened molleton cover of the form roller down to its final dimension. When you are using the fourth sheet, do not add water to the rollers. The molleton covering of the ductor roller will be rolled into its final dimension because of its contact with the fountain and oscillator rollers.

Blanket Care

A new offset blanket should be washed thoroughly with a cloth moistened with water and solvent and then again with solvent to remove the bloom before it is put on the press. To remove dried ink or glaze from a used blanket, you should scrub it with pumice powder and solvent; then powder the blanket with talcum powder.

If the blanket becomes soft and tacky or embossed to the point where powdering does not help, remove it from the press. Then clean and powder it well and store it in a cool, dark place for a week or two. It will then be ready to use again.

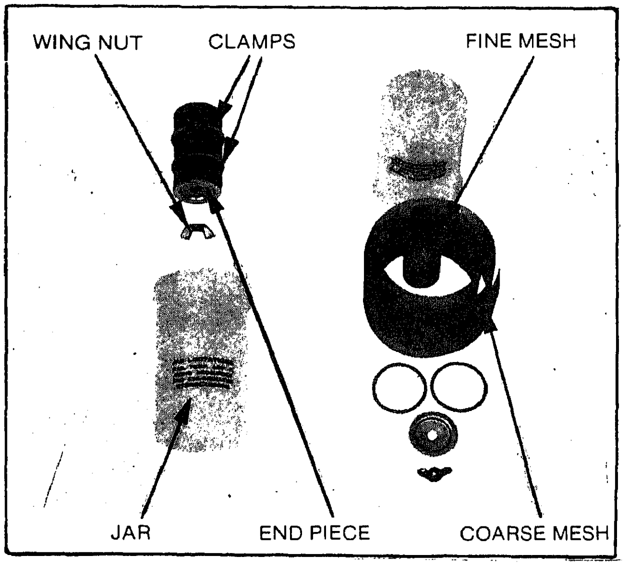
Vacuum Pump Maintenance

An oiler jar (see fig. 12-48) supplies oil to the vanes of the paper feeder pump found inside the cabinet below the impression cylinder. Oil in this oiler jar should be kept at a level of at least one-half of an inch from the bottom of the jar. When the jar is installed on the pump, a wick draws the oil inside the jar so that the pump receives continuous oiling.

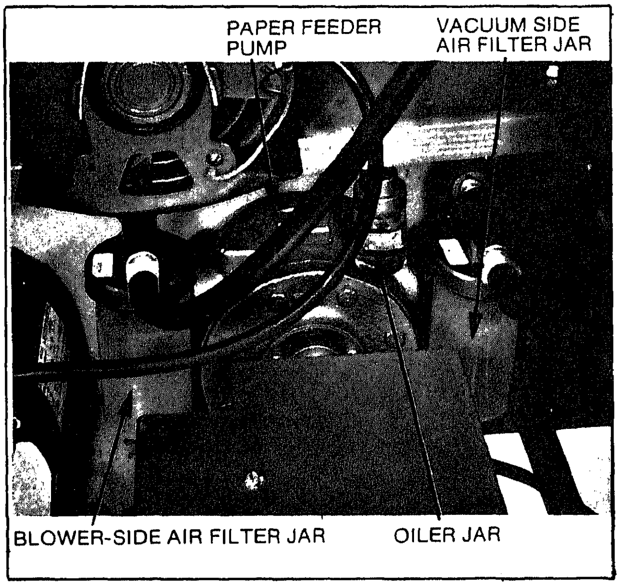
This pump has vacuum and blower ports with air filters in jars to prevent foreign material, such as paper lint, from entering its mechanism. The elements of these air filters consist of both coarse and fine layers of mesh screen. The filter elements and jars must be cleaned frequently.

To clean the filter elements, you should remove the jars and disassemble the wing nuts, washers, and clips before unrolling the mesh screens that are attached to the pump. Clean the screens by washing them in solvent. Then rinse and dry them, re-roll them and reassemble the filter elements on the pump. Also, wash the jars in solvent and wipe dry. It is normal to find a small amount of oil in the jar on the blower side of the pump.

Next, you should check the jars for cracks that would allow leakage. Before you replace the jars on the pump, wipe the air ports with a rag. When you are replacing the jars, be sure the gaskets are in place and the jars are seated snugly against the gaskets.



FILTER ELEMENTS AND OILER JAR PARTIALLY DISASSEMBLED (LEFT) AND COMPLETELY DISASSEMBLED (RIGHT).



57.424X

Figure 12-48.—Inside of the cabinet below the impression cylinder you will find the air filters for the vacuum pump.

STEP-BY-STEP OPERATIONS

1. At the beginning of the day and/or at regular intervals, clean and lubricate the press.

2. At the beginning of the day, move the night-latch knob to the horizontal position; then put ink in the ink fountain and run the press to distribute ink over the rollers.

3. Mix the fountain solution and fill and install the moisture fountain reservoir. Run the press to distribute solution over the moisture rollers. Use a sponge, if necessary.

4. Rotate the handwheel until the left side guide is at the end of its inward thrust. Then set the guide to a position along the locating scale which corresponds to the distance from the left edge of the plate to the left edge of the sheet.

5. Place a sheet of stock to be run on the conveyor tapes, at the end of the register board. Press the spring clamp and move the spring (right) side guide in until it contacts the right edge of the sheet and presses the paper against the left side guide with a slight pressure.

6. Lower the feed table. Set the piling bars, using the feed table scale.

7. Load the stock onto the feed table and raise the table until the top of the paper stack is one-fourth inch below the separator fingers. Set the back paper stop and paper guides to the back and side edges of the stack.

8. Set the caliper and adjust the sheet controls on the register board, if necessary.

9. Turn the press on and run a sheet through the feeder down the register board and check the settings you have made so far.

10. Stop the press before the sheet is delivered. Set the ejector wheels, ejector rings, and paper guides in the delivery unit, if necessary.

11. Examine the plate and mount it on the plate cylinder. Sponge the plate with fountain solution.

12. Move the moisture and ink form roller control knobs to their on positions. Start the press and move the single-lever control to moist; hold it there for several press revolutions. Move the single-lever control to ink; hold it there for several press revolutions. Replace this lever to the off position. Stop the press and examine the plate for proper inking.

13. If the plate is inking properly, sponge it again; turn on the press; drop the moisture and ink form rollers by moving the single-lever control to the INK position.

14. Turn on the vacuum to start the sheets feeding.

15. Place the single-lever control in the PRINT position.

16. After three or four sheets have been run through, shut off the vacuum; place the single-lever control in the OFF position. Shut off the press.

17. Check the image on the sheet for position.

a. If the image is not centered sidewise, make small adjustments with the micrometer wheel, which moves the left side guide, or move the left side guide, as required. (If movement of the side guide is excessive, it may be necessary to change the setting of the feeder and delivery units also.)

b. If the image is too high or too low, loosen the bolt on the edge of the plate cylinder and move the undercut section of the cylinder, as required. Wash the blanket before making (pulling) another impression.

c. If the image is crooked on the sheet, make minor adjustments by twisting the plate on the cylinder by turning the notched adjusting screws (in the cylinder gap) in the direction required. Wash the blanket before making another impression.

18. Check again for proper ink and moisture distribution. Adjust the ink and the fountain settings if necessary.

19. Check for spots that are not printing properly. If these spots are due to a worn or damaged blanket, change the blanket.

20. Sponge the plate; start the press, and run several more sheets until the ink and moisture are balanced.

21. Set the counter at 00000 and proceed with the press run.

22. Examine the work at regular intervals. Remove a sheet from the delivery pile about every 50 or 100 impressions. Watch the ink distribution. Adjust moisture and ink, as necessary.

23. Reload the feeder as stock is depleted; remove all sheets from the delivery unit, as necessary. Stack the printed sheets on a table.

24. After the run is completed, stop the press; transfer the plate to a table.

25. If plates are to be saved, go over metal plates with gum arabic solution; go over direct image and presensitized plates with the preservative solution recommended by the plate manufacturer. Rub the plate dry and store it.

26. Wash the blanket and prepare the press for next plate.

27. At the end of the day, remove the fountain solution from the fountain pan, and remove all ink from the ink fountain. Clean the ink and moisture rollers and blanket. Wash the ink fountain and rollers with solvent. Wash the blanket with solvent. Move the night-latch knob to the vertical position to relieve tension on the ink form rollers.

RUNNING HEAVY STOCK

It will be necessary for you to make a few simple adjustments to the press when you are running cardboards and heavy stocks.

Besides adjusting the suction and blast, the caliper, and the pile height bar, you may need to remove the sheet separator finger and to reset the upper feed roller. In addition, it may be necessary to change the pressure between the blanket and impression cylinders to allow this thickness of stock to pass.

If the stock is very thick, you should replace the regular blanket with an old one, as thick stock sometimes damages the blanket.

SAFETY

When operating or maintaining any of your lithographic equipment, ensure that all safety procedures are complied with. *Safety Precautions for Forces Afloat*, OPNAVINST 5100.19A, contains the current guidelines for safety in all areas of work.

Safety guards and safety covers should be in good working order. If any are missing or inoperative, they should be replaced or repaired as required. Voiding a safety is an open invitation for an accident or equipment damage.

SUMMARY

This chapter covered the Multilith offset presses models 1330 and 1360. The major difference in the presses is the maximum printing image area (size), which is 12 1/2 inches by 16 1/2 inches for the 1360 offset press and 12 1/2 inches by 13 inches for the 1330 offset press.

Most of the press controls are located on the operator's side of the press on both models which allows for more convenience and speed of operation.

The moisture system consists of four rollers: the fountain, ductor, oscillator, and form roller. Only the ductor and form rollers are molleton covered; the fountain and oscillator rollers are bare metal.

There are three inking systems available for the model 1330 or 1360 offset press. Each inking system differs in the number of rollers it contains. However, while providing different ink coverage, they all provide adequate coverage of ink for their designed purpose to the image on the offset plate. The plate then transfers its image to the offset blanket mounted on the blanket cylinder. And then the image is transferred (printed) onto the paper as the paper passes between the blanket and impression cylinders.

The automatic feeder holds the paper and feeds the paper into the press. As the paper passes the paper stops, it trips a counter, which keeps track of the number of sheets entering the printing unit while the press is on impression.

There are two types of delivery systems available for the 1330 or 1360 offset press. One is the standard paper receiver, and the other is the chain delivery unit with a paper table. The chain delivery is most often found on the 1360 offset press.

Press adjustments may be necessary on your equipment, but you should check with your supervisor before making extensive adjustments. Don't be tool happy! Maintenance of your offset press is a keynote for long, productive press life and quality of production. Knowing your maintenance and following a standard step-by-step operation will provide many added benefits, such as simplicity of operation and safety.

Don't learn or practice shortcuts or jury-rig procedures on your equipment. The shortcut may very well send you to the medical department. Safety is the golden rule. All shortcuts and jury-rig procedures violate safety rules or regulations. Almost all accidents result from a violation of a safety rule or regulation. Learn safety, train safety, and practice safety; safety is your best protection.

CHAPTER 13

THE A. B. DICK OFFSET DUPLICATOR

As you take an offset plate to the press, you may be required to operate an A. B. Dick Offset Duplicator (press). You will find that while the reproduction machines of this size are technically called duplicators, they are often referred to as presses.

A. B. DICK 9835 AND 385

The A. B. Dick Offset Duplicator, Model 9835, has a maximum image (printing) area of 12 1/2 inches by 17 1/4 inches, and the press will run a sheet as large as 13 1/2 inches by 17 3/4 inches. The smallest sheet you can run on the A. B. Dick Offset Duplicator Model 9835 is 3 inches by 5 inches.

The A. B. Dick Offset Duplicator, Model 385, has a maximum sheet size of 17 1/2 inches by 22 3/4 inches with a maximum image (printing) area of 17 1/8 inches by 22 1/4 inches. The smallest sheet you can run on the A. B. Dick Offset Duplicator, Model 385, is 3 1/4 inches by 5 inches.

The dampening system on these presses differs from that found on other offset presses in that the fountain solution (water) and ink are both fed to the plate from the same set of form rollers. When the press is in operation, the ink is distributed over all the rollers, including those in the dampening system. The fountain solution, in turn, is distributed not only to the rollers in the dampening system, but also to some of the ink rollers, as shown in figure 13-1. Thus, the ink form rollers are covered with a film of fountain solution, as well as with a layer of ink. As the offset plate travels against these form rollers, the rollers give up their moisture to the non-image areas of the plate and transfer the ink to the ink-receptive image areas.

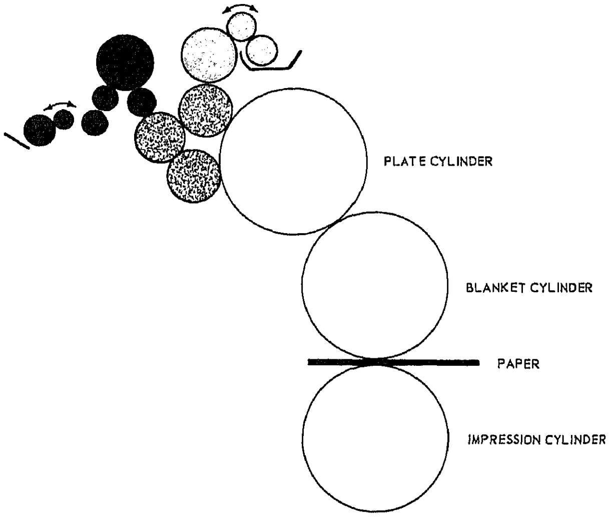


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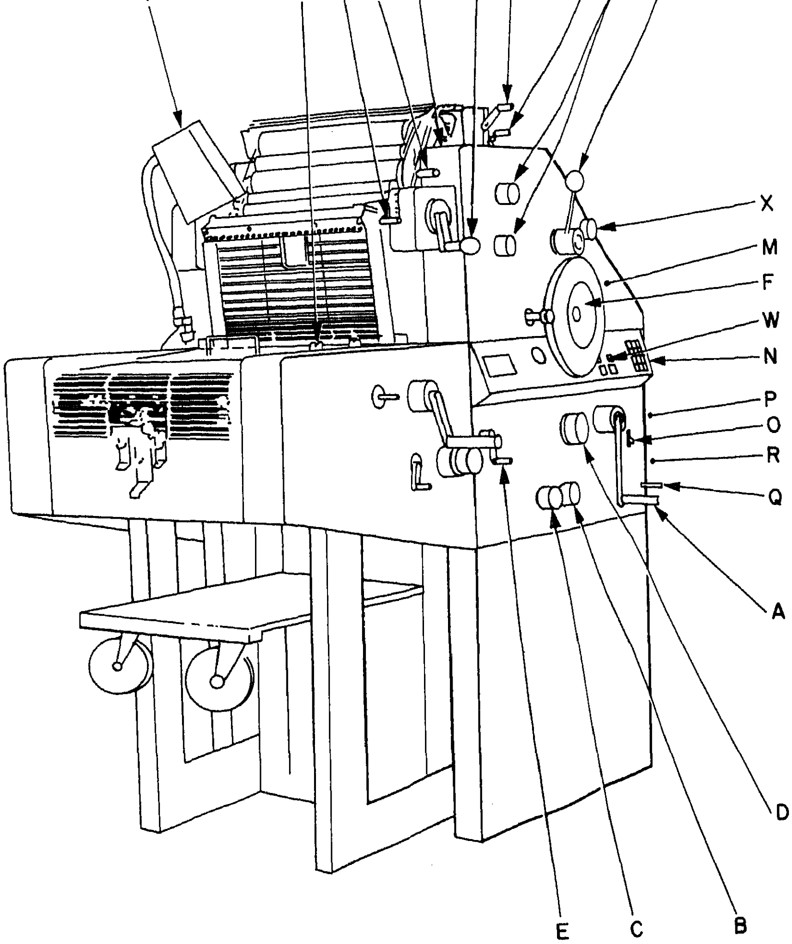
Figure 13-1.—Diagram of the inking and dampening system rollers on an A. B. Dick Offset Duplicator. When the press is in operation, ink is distributed to all rollers including those in the dampening system. Fountain solution is distributed over the ink form rollers and lower ink oscillator as well as over the dampening system rollers.

The A. B. Dick Company produces a line of inks, fountain solutions, and other lithographic supplies specially formulated for use with their equipment. However, any good ink or fountain solution can be used on these presses without creating operating problems.

OPERATOR CONTROLS

The main difference between the offset duplicator, 9835 and 385 models, is in the operator controls. All of the press functions during the operation of the presses are similar on both models.



A. Paper elevator crank
B. Vacuum control
C. Air Control
D. Buckle control
E. Speed control
F. Handwheel
G. Form rollers control knobs
H. Ink fountain roller crank
I. Aquamatic lockout latch
J. Aquamatic control
K. Aquamatic night latch handle
L. Operation control lever
M. Vertical copy adjusting lock
N. Copy counter
O. Table release
P. Paper stack height adjustment
Q. Paper guide crank
R. Feed table
S. Aquamatic lockout release knob
T. Ink control lever
U. Paper feed control (rear)
V. Work light
W. Master cylinder pressure control
X. Control panel

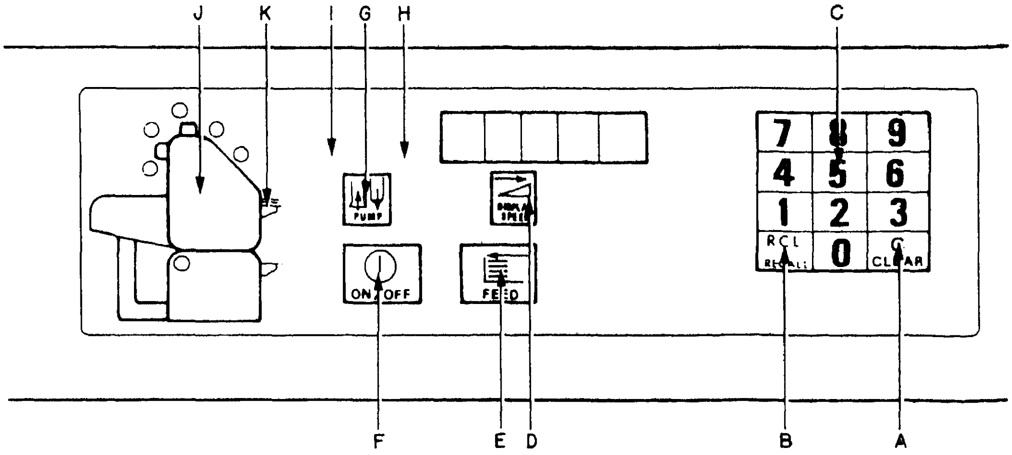
57.376

Figure 13-2.—Operator controls of the A. B. Dick Model 9835.

The location of the operator controls for the Model 9835 offset duplicator is shown in figure 13-2 and 13-3.

The press on/off switch, vacuum pump switch, counter, jam indicator, feed, display speed, double indicator, clear button, recall button, and paper-low indicator are all located on the control panel. The control panel can be located in figure 13-2 and then studied more closely in figure 13-3.

The clear button is used to clear the LED display and reset the jam and doubles indicator after correcting any problems.



A. "C" Clear button
B. "RCL" Recall button
C. 09 Number buttons
D. Display Speed button
E. Feed button
F. On/Off button
G. Pump button
H. Jam indicator light
I. Doubles-indicator light
J. Safety-cover indicator
K. Paper-low indicator

57.377

Figure 13-3.—Control panel of the A. B. Dick Model 9835.

When you press the RCL (recall) button during machine operation, it will display the initial number of copies entered onto the LED display as long as the button is depressed. Using the buttons numbered 0 through 9, you can enter the number of copies you need up to 99,999. To find out your current press speed during press operation, depress the display speed button. The speed will be indicated on the control panel for 10 seconds or until you press the clear button. By pressing the feed button you can turn the vacuum pump and paper feed on and off.

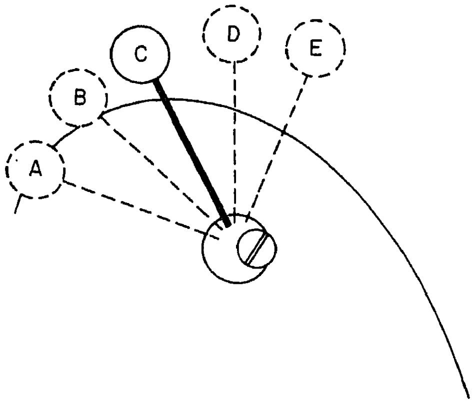
To turn the drive motor on and off, you should depress the on/off button. The pump button turns the vacuum pump on and off. (The vacuum pump will remain on regardless of the position of other machine controls until such time as it is turned off using the pump button.) The jam indicator light comes on only when a sheet of paper does not exit the machine after feeding.

Note: When the paper does not exit the machine, the paper feed shuts off automatically. To resume operation, you must turn off the duplicator, remove the jammed paper, restart the duplicator, and press the clear button.

The doubles-indicator light comes on when the doubles detector senses more than one sheet feeding through the duplicator.

Note: When more than one sheet is feeding through, the main drive motor continues to operate, but the paper feed shuts off automatically. To resume operation, you must turn off the duplicator, remove the extra sheet(s), then restart the duplicator and press the clear button.

There are six safety cover indicators. They are in a series starting with the base cover and moving in a clockwise direction to the blanket cylinder cover. Only one area indicator will light at a time regardless of the number of safety covers that may be open. When you open two or more safety covers, the indicator that lights will always be the one closest to the base cover. After that cover is closed, the next indicator to light will be the one whose cover is open that is next in the same clockwise sequence.



A. Night latch
B. Neutral
C. Ink
D. Image
E. Feed

57.755

Figure 13-4.—The five positions of the operation control lever.

> Note: The drive motor will automatically shut off and will not operate while a safety cover is open.

The paper-low indicator flashes when there are approximately 100 sheets of 20-pound paper remaining on the feed table. The beeper will also be activated to provide an audible indication of this condition. The paper will still feed, but the flashing will continue until you lower the feed table. To cancel the beeper, press the clear key.

As you can see in figure 13-4, the operation control lever for the printing unit for the Model 9835 can be shifted into five positions. In the extreme left position (toward the delivery end of the press) the lever relieves tension on the ink form rollers. This position of the lever is referred to as the night latch position; it is used when the press is shut down for longer periods, such as between shifts or overnight. Moving the lever to the neutral position breaks contact between the ink form rollers and the offset plate on its cylinder when the press is idling (running but not actually printing). When the lever is in ink position, the form rollers are in contact with the plate. Moving the lever to image position brings the plate and blanket cylinders into contact and transfers the printing image to the rubber blanket. When you hold the lever in the extreme right position (toward the feeder end of the press), sheets of paper are fed into the press. When the lever is released, the handle automatically returns to the ink position and the paper feeding stops. This feature enables you to have positive control of the feeder whenever you need to feed only one or two sheets during makeready, or when you want to check the sheets after making an adjustment during the pressrun.

The location of the operator controls for the Model 385 offset duplicator are shown in figure 13-5. The motor drive switch and vacuum pump switch are located just forward of the handwheel. Continuous feeder operation is started by raising the paper feed control lever. The Model 385 offset duplicator is not equipped with the operation control lever for the printing unit that you find on the Model 9835 offset duplicator.

INKING UNIT

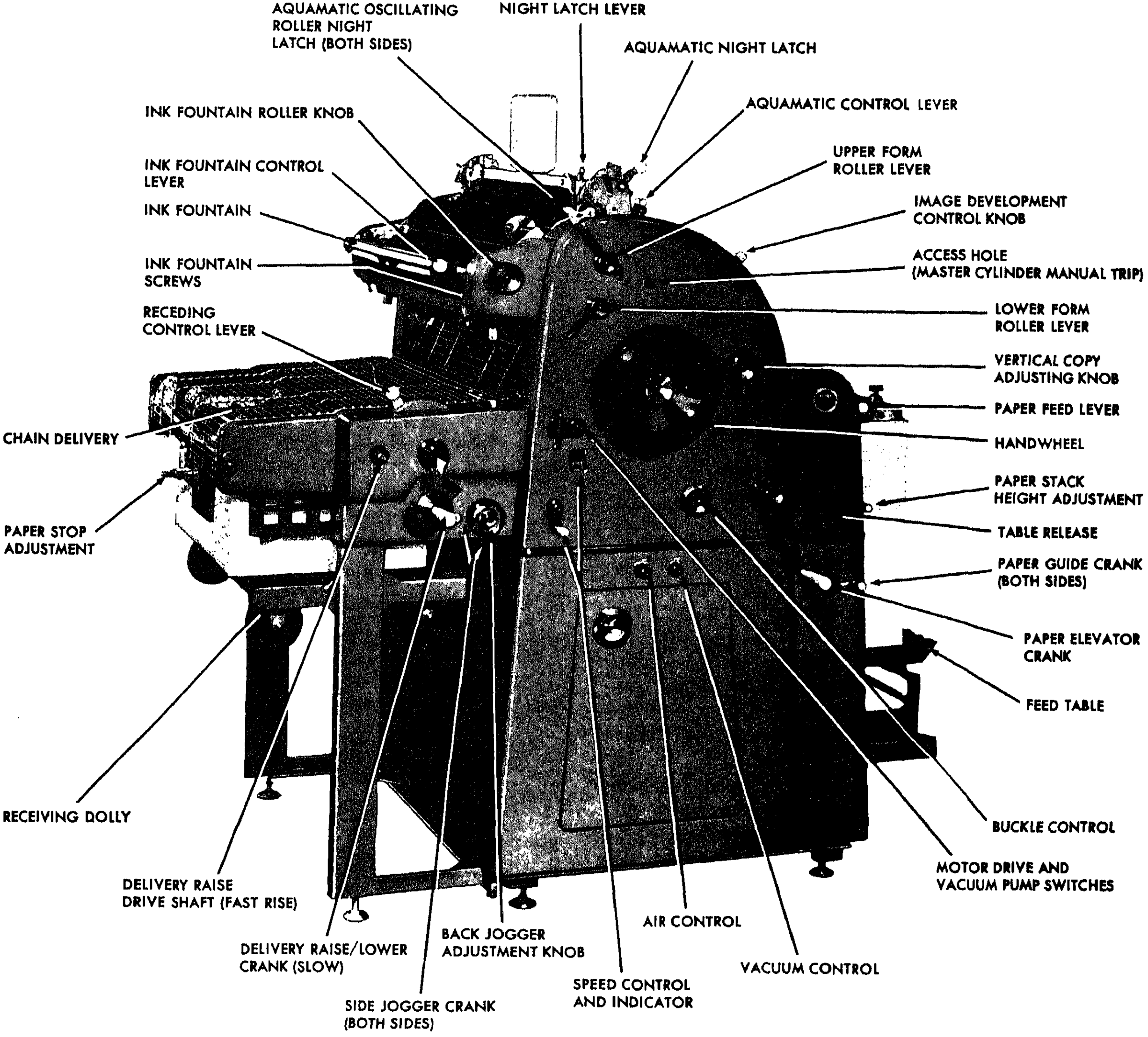
The inking unit on the 385 model consists of an ink fountain, fountain roller, ductor, two oscillators, three distributors, two form rollers, and various operating controls.

The ink supply is regulated by the conventional (thumb) screws on the fountain and by the setting of the ink fountain control lever shown in figure 13-5. To increase the ink supply to the system, you should move the control lever toward the feeder end of the press; to decrease the supply, you should move the lever in the opposite direction. When you move the lever to the position marked off, the ink fountain roller ceases to turn and the ink feed is shut off completely.

The ink fountain roller knob rotates the ink fountain roller by hand when you are setting the fountain keys at the beginning of the day or when you wish to increase the supply of ink momentarily during the pressrun. This knob is designed to be turned only in a counterclockwise direction for proper operation. The upper and lower form roller levers, shown in figure 13-5, are for raising and lowering the form rollers. This action causes the form rollers to either make or break contact with the offset plate on its cylinder.

Once you have lowered the form rollers at the beginning of the day on the 9835 model, it is not necessary to raise them with the form roller control knobs each time you shut down the press. Instead, you can simply move the operation control lever to the neutral position.

The Model 385 offset duplicator is not equipped with an operation control lever. It is, therefore, necessary to use the upper and lower


AQUAMATIC OSCILLATING ROLLER NIGHT LATCH (BOTH SIDES)
NIGHT LATCH LEVER
AQUAMATIC NIGHT LATCH
INK FOUNTAIN ROLLER KNOB
AQUAMATIC CONTROL LEVER
INK FOUNTAIN CONTROL LEVER
UPPER FORM ROLLER LEVER
INK FOUNTAIN
IMAGE DEVELOPMENT CONTROL KNOB
INK FOUNTAIN SCREWS
ACCESS HOLE (MASTER CYLINDER MANUAL TRIP)
RECEDING CONTROL LEVER
LOWER FORM ROLLER LEVER
VERTICAL COPY ADJUSTING KNOB
PAPER FEED LEVER
CHAIN DELIVERY
HANDWHEEL
PAPER STACK HEIGHT ADJUSTMENT
PAPER STOP ADJUSTMENT
TABLE RELEASE
PAPER GUIDE CRANK (BOTH SIDES)
PAPER ELEVATOR CRANK
FEED TABLE
RECEIVING DOLLY
BUCKLE CONTROL
MOTOR DRIVE AND VACUUM PUMP SWITCHES
DELIVERY RAISE DRIVE SHAFT (FAST RISE)
AIR CONTROL
BACK JOGGER ADJUSTMENT KNOB
DELIVERY RAISE/LOWER CRANK (SLOW)
VACUUM CONTROL
SPEED CONTROL AND INDICATOR
SIDE JOGGER CRANK (BOTH SIDES)

57.378X

Figure 13-5.—Operator's controls of the A. B. Dick Model 385.

form levers (shown in fig. 13-5) each time you wish to raise or lower the ink form rollers. You should use the night latch position of these levers when you shut down the press for an extended period of time.

The press cylinders are normally out of contact with one another when paper is not feeding through the press. However, on the Model 385 offset duplicator, you can use the image development control knob shown in figure 13-5 to build up the image on the blanket before you start to feed paper. When you push this knob down, it causes the plate cylinder to lower against the blanket without moving the impression cylinder against the blanket. Hold the knob down for three or four revolutions of the press to build up the image on the blanket before you start the feeder. After feeding and printing a sheet, you should have a good print on the first sheet fed through. Spring tension will cause the knob to return to its original position as soon as you release it.

AQUAMATIC UNIT

The dampening unit of this press is called the aquamatic unit. It consists of a fountain, a bottle that acts as a reservoir for the fountain solution, a copper fountain roller, a rubber composition ductor roller, and a hard rubber oscillating roller. None of these rollers require molleton or paper covers, like those used on the rollers in other dampening systems.

Figure 13-5 shows the operating controls for the aquamatic unit. You can regulate the supply of fountain solution by moving the aquamatic control lever along the scale on the press frame. Moving the lever toward the higher numbers increases the amount of fountain solution going into the system and vice versa. The lever on the scale is generally set at 45 to provide the maximum water supply during makeready operations at the beginning of the day. The lever is later moved back to a setting around 20 or 25 when the run actually begins. Of course, this setting varies with the speed of the press or the type of paper or ink being used. You can shut off the water supply completely by moving the lever all the way back to the position marked off.

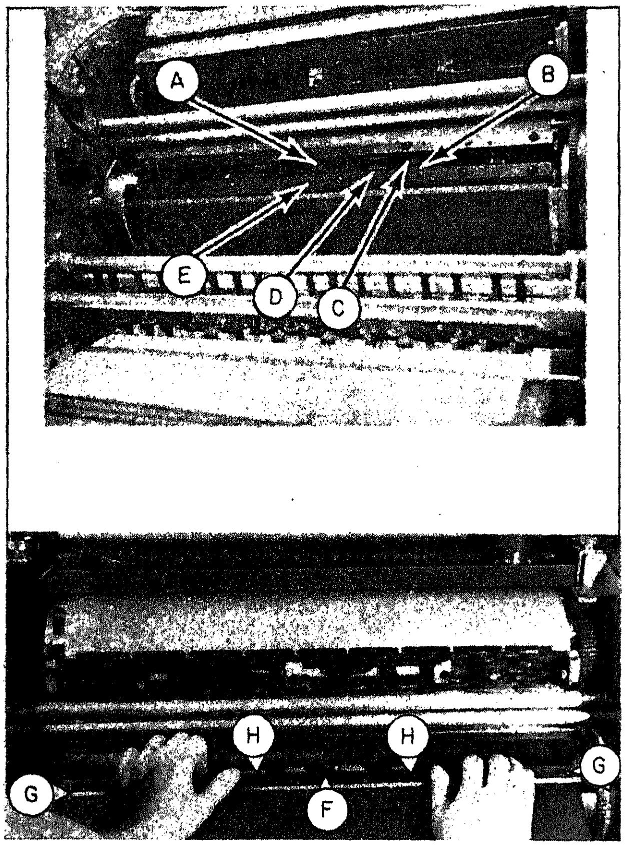
The aquamatic night latch shown in figure 13-5, is used to relieve pressure on the aquamatic ductor roller when the press is shut down. Push the latch toward the feeder end of the press to raise the ductor and push it in the opposite direction to bring the ductor back into operating position.

The aquamatic oscillating roller is generally removed from the press and placed on a support bracket during long shutdown periods. This roller must be replaced and the night latch must be moved to its operating position before the press is started again. When replacing the oscillating roller, fit the hole on the far end of the shaft over the drive pin and slip the other end of the shaft into the slide guides.

The aquamatic ductor night latch shown in figure 13-5 is also designed to prevent extra water from backing into the inking system when the press is turned backwards. You should keep it in a down position (toward the delivery end of the press) at all times except during morning makeready and wash-up operations.

BLANKET CYLINDER

The blanket cylinders of the offset duplicator Models 9835 and 385 are similar to the ones found on larger offset presses that were discussed in chapter 11 of this manual. The Model 385 offset duplicator requires packing under its blanket while



- **A. Center bolt. Turn so the head presses against the tail-end blanket bar.**
- **B. Locknuts.**
- **C. Tension bolts. Tighten to draw blanket taut.**
- **D. Snaps or latches that hold the blanket bars in place.**
- **E. Center hole of tail-end blanket bar.**
- **F. Cylinder gap.**
- **G. Retaining pins for blanket bar.**
- **H. Snaps or latches that hold the blanket bar in place.**

113.310X

Figure 13-6.—Blanket cylinder adjustments and mounting the blanket.

To change the blanket on the Model 385 press, you should turn the handwheel until the blanket cylinder gap comes into view. (See fig. 13-6). Then loosen the blanket center bolt, shown in the top illustration of figure 13-6, and loosen the locknuts and the tension bolts on the upper and lower gripper-end bars.

Insert a pin wrench in the center hole in the tail-end blanket clamp, release the two latches on the lower gripper base that are holding the blanket bar, and tilt the blanket bar to disengage it from

Keep tension by pulling on the blanket and packing while you rotate the cylinder with the handwheel until the gripper-end blanket bar comes into view. Unlatch and remove this bar using the procedure just discussed for the other blanket bar.

Remove the blanket bars from the old blanket by first loosening (but not removing) the socket head screws. To do this, turn the socket head screws until they back out and release the blanket. If the bars stick to the blanket, you may have to pry them off with a screwdriver.

You should check (measure) the blanket and packing for thickness with a micrometer before mounting the new blanket. The process of making this check is referred to as "miking." After miking the blanket you must add enough packing to bring the total blanket-plus-packing thickness up to 0.073 inch.

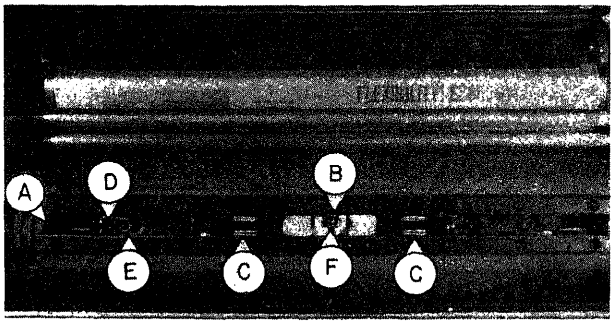
Check the new blanket to be sure it is the correct size and that it is square. It is not necessary to punch holes in the blanket. The blanket bars hold it securely once it is inserted into them.

To mount the blanket on the bar, you should insert the blanket squarely against the shoulder in the clamp of the bar. The rubber (printing surface) side of the blanket should be facing the same direction as the heads of the socket head screws. Center the blanket so that an equal amount protrudes at each side of the blanket bar and tighten the socket head screws. This mounting procedure is the same for the blanket bar at each end of the blanket.

Snap the lead edge blanket bar into place between the two retaining pins at the end of the cylinder, as shown in the lower part of figure 13-6. There is a lip at the edge of the blanket bars that slips into a similar lip on the cylinder. Check to see that the lips are engaged for their entire length; then snap the latches against the bar to hold it in place.

Next, take your required packing and bend one edge to produce a very narrow lip in one end. Lift the blanket and insert the packing sheet under it with the lip overlapping the leading edge of the cylinder so that the packing will not slip during the pressrun.

Hold the trailing edge of the blanket and the packing while you turn the handwheel to wrap the blanket and packing around the cylinder. When you reach the cylinder gap again, insert a pin wrench in the center hole of the tail-end bar. (See fig. 13-6.) Tilt or lift the bar up over the full length of the lip, seat the blanket bar, and then snap the two latches in place to secure it. Tighten the four tension bolts uniformly to draw the blanket taut. Secure the tension bolts with their locknuts; (fig. 13-7) then turn the center bolt so that the head presses against the tail-end bar.



A. **Cylinder gap.**
B. **Center hole in tail-end bar.**
C. **Snaps or latches that hold tail-end blanket bar in place.**
D. **Bolts (one of four).**
E. **Locknuts.**
F. **Center bolt. Seat against tail-end blanket bar.**

113.311X

Figure 13-7.—Drawing the blanket taut.

PLATE CYLINDER

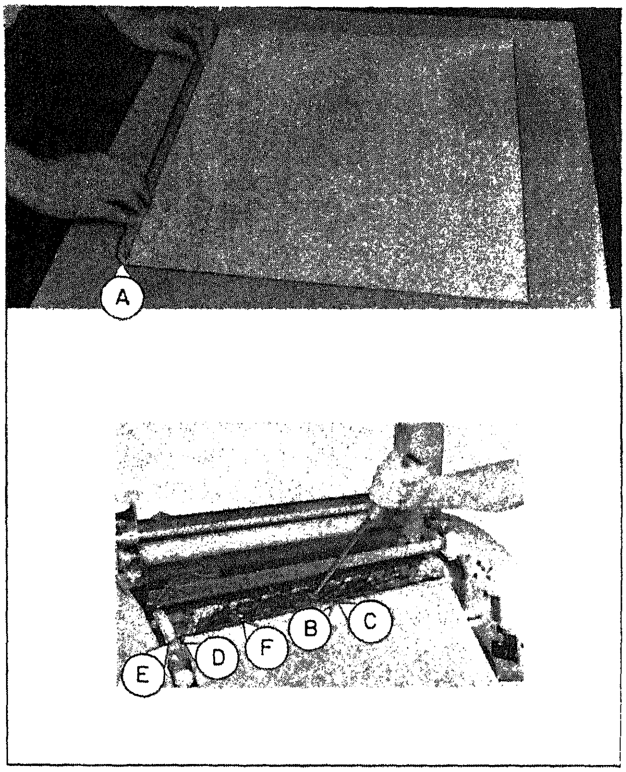
The plate cylinders of both the offset duplicators, Models 9835 and 385, are similar except that the 9835 model has a head (lead) clamp that will hold either slotted, serrated or straightedged plates. A spring trailing tail clamp at the other end of the plate cylinder holds the plate taut.

The 385 model has a plate clamp that can accommodate any design of plate edge. To use these clamps, you must lock the plate in position on the plate cylinder at both the head and tail ends of the cylinder.

Mounting the Plate

On the offset duplicator, Model 9835, you mount plates in a similar manner to the method used for the Multilith 1330/1360 that was discussed in chapter 12 of this manual. So as you mount plates on the Model 9835, you should refer to that chapter and use your manufacturer operator's manual. Here, we will discuss only the 385 model because of its differences in plate mounting procedures.

The plates used on the offset duplicator, Model 385, are normally 0.006 inch thick and require no underpacking. The plate cylinder will



A. Plate-bending device.
B. Center mark put on the plate by the platemaker for register purposes.
C. Center mark on plate clamp. Match with center mark on plate.
D. Register mark at edge of plate clamp. Should align with middle mark of lines (D). If it does not, raise or lower the clamp with the knurled screw (E).
E. Register lines.
F. Knurled screws used for moving the plate clamp to straighten the image on the paper.

113.316X

Figure 13-8.—Plate-bending device and plate cylinder adjustment.

accept either paper masters or metal plates with straightedged, slotted, or punched edges. You can bend the tail edge of the metal plates at a 45-degree angle before mounting them on the press. The plate-bending device shown in figure 13-8 is provided for this purpose. Slip the trailing edge of the plate into this device; then lay the plate face down on the table and bend it in the manner shown in the illustration.

A special tool is provided with this press by the manufacturer for locking the plate on the plate cylinder. This tool, which consists of a wooden handle holding a round metal shaft with a blunt the tail and head clamps. Using this tool, you can turn the pivots to the right to open the clamps on the cylinder and to the left to close and lock the plate on the cylinder.

Insert the leading edge of the plate in the head (bottom) clamp and center the plate by matching the center mark (provided on the plate) with the centering mark on the head clamp. (See fig. 13-8.) Turn the pivot to lock the clamp and check to see that the mark on the edge of the clamp aligns with the middle mark shown in the illustration. If it does not line up, you may be able to compensate by turning the knurled adjusting screw to raise or lower the clamp.

You should now hold the tail edge of the plate with one hand and turn the handwheel with your other hand to draw the plate around the cylinder. When the tail clamp comes within reach, insert the bent edge of the plate into the tail clamp, then close and lock the clamp by turning the pivot.

You can run narrow plates on these presses without inking the cylinder surfaces and smearing the copies, because the plate and impression cylinders are chrome plated and the chrome tends to repel the ink. Before running a narrow plate, you should clean the surfaces of the cylinders with a chrome cleaner. Then coat the plate cylinder with fountain solution to protect the surface from ink contamination.

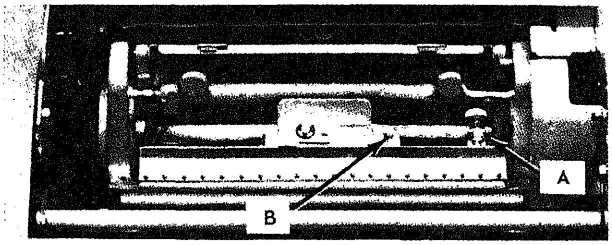
Image Adjustments

By moving the plate cylinder head clamp on the offset duplicator, Model 9835, you can make two adjustments to position the image.

When the image is printing crooked on the press sheet, you can correct it by turning the knurled knob for straightening the image, shown in figure 13-9. If the image is down from right to left, turn the knob counterclockwise to straighten it. If the image is running upward from left to right, turn the knob clockwise to straighten it. When you are using straightedge plates, you can adjust the image on the press sheet by releasing the plate head clamp and moving the plate in the desired direction.

If the image is not positioned correctly side-to-side, you can make a slight adjustment (up to one-fourth inch) by turning the knurled knob for shifting the image sidewise, shown in figure 13-9. When the side-to-side adjustment is greater than one-fourth inch, you must move the paper pile and change the feeder setup.

On the 385 model, if the image is slightly



A. Knurled knob for straightening image.
B. Knurled knob for shifting image sidewise.

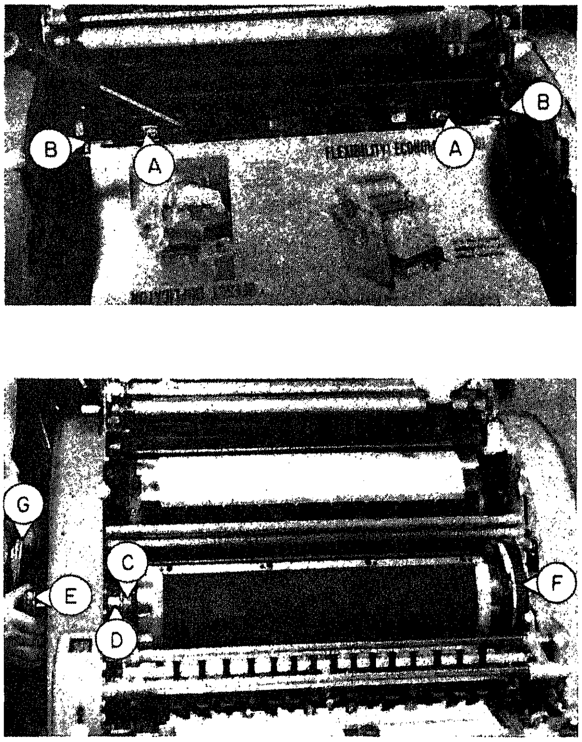
57.317X
Figure 13-9.—Image adjustment controls located on the plate cylinder head clamp of the A. B. Dick Model 9835.

compensate for the crookedness by cocking the plate on the cylinder at an angle. To do this, loosen the tail clamp and turn one of the knurled screws shown in the top illustration of figure 13-10 to move the gripper edge clamp above or below the horizontal centering marks on the cylinder.

When you loosen the tail clamp, the plate tends to creep up on the cylinder. You must take both hands and pull the plate taut before relocking it into the tail clamp. If you do not do this, the plate may not hug the cylinder properly and the plate could become damaged when you start the press again.

If the image is not positioned properly on the press sheet sidewise, you can reposition it by moving the paper stack on the feeder table and changing the feeder setup, or you can make a small sidewise adjustment (up to one-fourth inch) by releasing the plate from the plate clamps and shifting it on the cylinder.

On both the 9835 and the 385 models, if the image prints too high or too low on the paper, you can raise it 5 1/2 inches or lower it 6 1/2 inches by moving the impression cylinder. To do this, you must turn the handwheel until the locknut aligns with the built-in lock or socket attached to a print adjusting gear. (See fig. 13-10.) Then push in on the locking knob, engage and turn it counterclockwise to loosen the locknut. Continue to hold the locking knob in so the blanket cylinder will not turn while you rotate the handwheel to move the scale in the direction marked RAISE or LOWER.



A. Knurled screws. Loosen the tail clamp and turn these screws to cock the plate on the cylinder.
B. Horizontal centering mark.
C. Locknut.
D. Lock or socket.
E. Locking knob. Push in and turn counterclockwise to release locknut (C).
F. Scale.
G. Handwheel for turning press manually.

113.320X, 57.318X
Figure 13-10.—Image adjustment.

After you have made the adjustment, turn the locking knob clockwise to tighten the locknut; then release it. Spring tension will cause the locking knob to return to its original position when it is released.

There are two sets of gears at the far end of the blanket cylinder, but only the outer gear moves when an adjustment is being made, thus the relationship between the plate and blanket cylinders changes. This makes it unnecessary for you to wash (clean) the image from the blanket before pulling another proof or press sheet.

Image Control Development Lever

The press cylinders are normally out of contact with one another when paper stock is not feeding through the press. However, on the Model 385 offset duplicator, you can use the image control development lever to build up the image on the blanket before you start the feeder.

When you push this lever down, it causes the plate cylinder to lower against the blanket on its cylinder without moving the impression cylinder against the blanket. You should hold the image control lever down for three or four revolutions of the press so the image will build up on the blanket. Then you can start the feeder so that you will create a good impression on the first sheet fed through the press. Once the image has been built up on the blanket, you should move the image control development lever back to its original position.

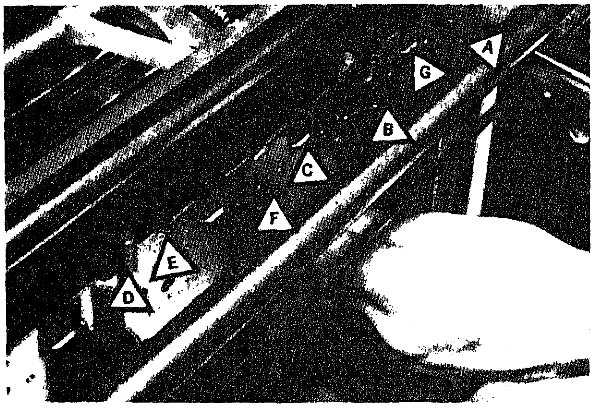
AUTOMATIC FEEDER

The feeder on these presses differs from that found on other presses in that the paper stock is fed directly from the feed table into the printing unit. These presses do not have a register table, conveyor tapes, moving side guides, or front guides.

The piling bar shown in figure 13-11 is similar to that found on other presses. There are two piling bars; however, only one is shown here. They are positioned along the scale facing the front of the feed table (fig. 13-12) and the piling bars guide the paper stock as it is forwarded into the printing unit.

When the press is in operation, a blast of air is emitted from blower tubes and from the pile height regulators at the front of the stack.

The spring guide, shown in figure 13-13, is equipped with a steel spring that forces the top sheets in the pile against the side guide. The side guide acts as the registering guide so that each sheet will enter the printing unit in the same position. These guides are interchangeable so that you can register the sheets from either side of the press.

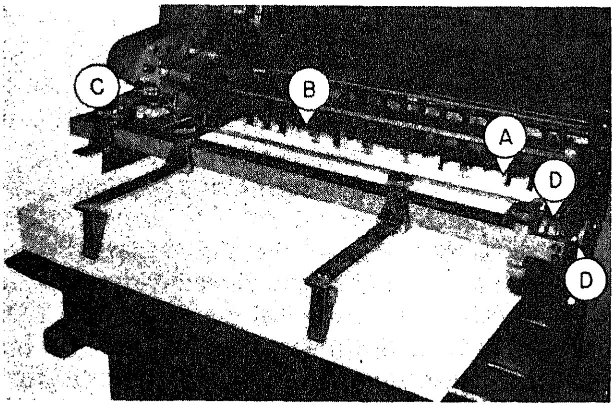


A. Piling bar. Position along scale (B) by turning a crank at the side of the press.
B. Scale on front plate used in setting the piling bars.
C. Pile height regulators.
D. Blast pipe.
E. Spring separator fingers.
F. Setscrew for moving separator fingers (E) forward or backward.
G. Front plate.

113.322X

Figure 13-11.—Pile bar.

Air floats the top sheet in the pile and the spring guide forces the sheet against the side guide and the right piling bar to register it sidewise. At the same time, the springs on the back stops force the sheet forward against the front plate (a plate at the front of the pile). The sucker feet then dip down and catch the leading (front) edge of the sheet and move it under a set of rubber forwarding rollers that are traveling against a knurled metal roller. The forwarding rollers force the sheet directly into the impression cylinder grippers, as



A. Blast pipes.
B. Pile height regulator.
C. Paper weight (bail). Controls sheet as it is floated by the blast.
D. Micro-adjustment screw (knob) for side guide (E) shown in figure 13-8.

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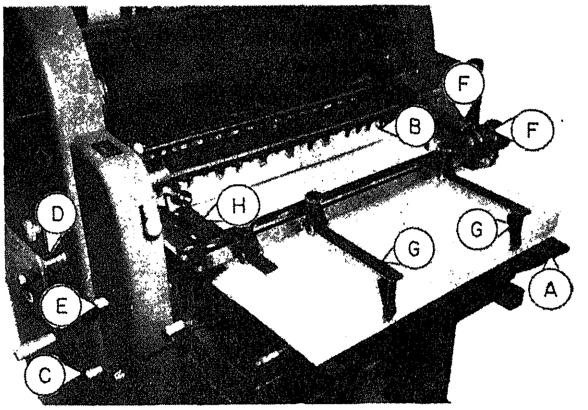
Figure 13-12.—Feed table.



- A. Wooden support beams. Set to clear the pile back stops, the pile height regulators, the side guide, and the side guide spring as the table rises to its maximum height as the last sheets are fed into the press.
- B. Side guide.
- C. Crank for setting piling bars. There is a similar crank on the other of the press.
- D. Crank for raising and lowering feed table.
- E. Feed table release. Push the two sections together and push down to release table. Push in opposite direction to lock table in place after it is raised.
- F. Knurled screws. Loosen to move side guide (B).
- G. Back stops.
- H. Spring guide. Move against left edge of stock to register against right piling bar and vice versa. Reverse spring if guide is switched to the opposite side.

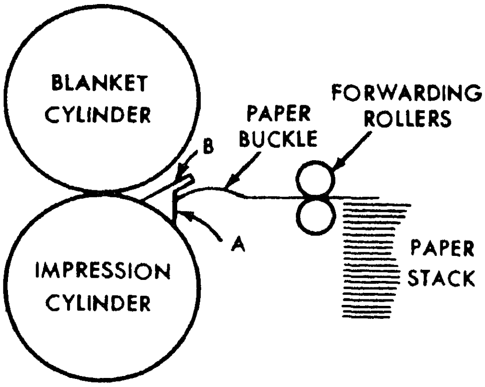
57.319X

Figure 13-13.—Feed table controls.

shown in figure 13-14. As the grippers open to receive the sheet, the paper stops rise from the recess in the impression cylinder and the paper is forced against these stops in much the same manner as the paper is registered against the front stops other register tables. Since the paper sheets can go no further after reaching these stops, the action forms a slight buckle in the paper before the sheet is drawn into the printing unit. This buckle (overfeed) has an important effect on registration. If there is too much buckle, the stock may be nicked along the leading edge; and if there is not enough buckle, there may be insufficient gripper bite on the edge of the sheet to pull the sheet through. You can regulate the amount of overfeed with the buckle control knob. This knob changes the feeder timing by moving the sucker feet forward or backward, thus controlling the distance the sheet is fed into the grippers in the allotted time.

Setting the Feeder

You can move the left piling bar sidewise by turning the crank for setting piling bars, and you can set the right piling bar by turning a similar crank on the other side of the press.



- A. Stop.
- B. Gripper.

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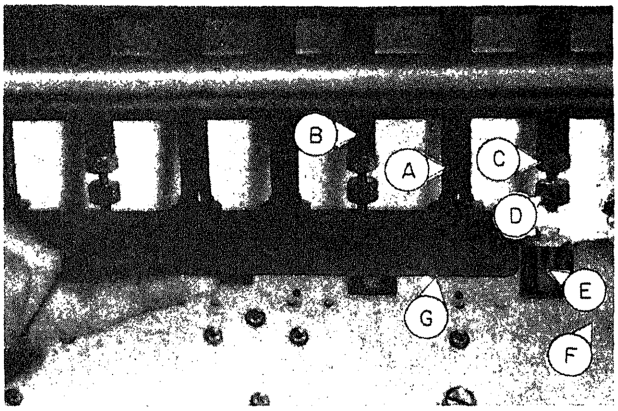
Figure 13-14.—Diagram showing how stock buckles as it feeds into the gripper stops.

If you wish to register to the right side, you should move the right piling bar to the position on the scale at the front of the feed table that corresponds to the width of the stock being run. If the stock is 8 1/2 inches wide, for example, you should turn the handle until the piling bar is positioned at 8 1/2 on the scale. The other piling bar should be set to just clear the other edge of the stock. You should reverse this procedure if you wish to register the sheet to the left, of course.

Next, you should depress the feed table release and push in and turn the crank clockwise for raising or counterclockwise for lowering the feed table.

Move the wooden support beams, if necessary, so that they will clear the paper pile back stops, the side guide, the (side) spring guide, and the pile height regulators, when the feed table rises to its maximum height as the last of the paper in the pile is fed into the press. You can slide the support beams sidewise to position them, or you can lift up on them and remove them from the bar when you are running narrow sheets.

Next, jog the paper stock and load it onto the feed table. You can load up to a 20-inch stack on the feed table at one time on the 385 model or approximately 5,000 sheets of 20-pound stock on the 9835 model.



A. Sucker foot.
B. Paper leveler.
C. Locknut.
D. Leveler.
E. Pile height regulator. Controls climb of feed table. Also acts as a blast pipe and a sheet-separator finger.
F. Front plate.
G. Straightedge.

113.324X

Figure 13-15.—Illustration showing how to use a straightedge in aligning the paper levelers and sucker feet. The paper levelers are usually set just slightly below the sucker feet.

After the stock has been loaded, you should raise the feed table until the top of the stack contacts the four pile height regulators, shown in figure 13-15, when the regulators are in their lowest position. Press the two sections of the feed table release together and pull up to lock the feed table in place. (It may be necessary to rotate the press either manually or under power slightly to move the pile height regulators to their lowest position.)

Square the top sheets of the pile against the front plate and the piling guide on the registering side that you are using. Then loosen the two knurled screws used to move the side guide against the edge of the paper stack. (If further side guide adjustments are required after the pressrun commences, you can make minute adjustments to the side guide with the micro-adjusting screw (knobs).

Next, set the paper spring guide and the back stops against the pile of paper. If you are registering to the right side, set the spring guide along the left side of the stack and move it in until the spring contacts the edge of the stock and is depressed by about one-eighth of an inch. Reverse the positions of the side guide and the spring guide if you are registering the sheets to the left side of the press.

Set the back stops to press lightly against the back of the pile of paper if you are running thin or medium weight stock. Set it to allow a slight clearance between the back stop and the pile when you are running heavy stock.

Paper Weight

The paper weight is a wire bail located above the feed table that controls the sheet as it is floated by the blowers. There are three holes or positions for this wire. When you are running lightweight paper stocks, you should place it in the position nearest the forwarding rollers; move it back to the middle position for medium paper stocks; and move it all the way back to the last position for heavy paper stocks.

Pile Height Control

The pile height regulators, shown in figure 13-15, move up and down when the press is in operation. As the paper is fed into the machine, the pile height regulators move lower and lower until they finally allow a pawl to engage, which turns an elevating ratchet and raises the feed table. This action keeps the height of the paper stack constant as the paper is fed from the feed table and into the press.

You can make the stack run at a higher or lower level with the pile height control. Most operators set this lever at five on the scale for 20-pound stock. They run the stack slightly higher if they are running heavier paper stock and slightly lower when running lightweight paper stocks.

Paper Levelers

The paper levelers, shown in figure 13-15, help to prevent double sheeting and assist in feeding lightweight paper stocks. They create a wavy edge on the sheet as it is picked up by the suckers. As the sheet is lifted by the sucker feet, the sheet separator fingers extending from the top of the front plate separate the top sheet from the sheet below.

The paper levelers of the 385 model are attached to the same bar as the sucker feet and are interchangeable with the sucker feet. The 9835 model uses the sucker feet with their shut-off valves closed, as paper levelers. You can open more of these valves if you need more operating sucker feet when running heavier paper stock.

You can place the paper levelers in any position along the bar desired. As a rule, they are spaced at equal distances between the sucker feet along the sucker foot bar, but you should not place the paper levelers at the side edges of the sheet. You should use all four of the levelers when you are running a large sheet, but two are sufficient when you are running 8 1/2- by 11-inch stock. It is sometimes desirable to replace the paper levelers with sucker feet when you are running card stock. Be sure they are not placed directly in front of the pile height regulators.

You can raise or lower the paper levelers as necessary. You should set them slightly higher than the sucker feet when the sucker feet are all the way down (in their lowest operating position) when you are running card stock and slightly lower than the sucker feet when you are running lightweight paper stock. Set the paper levelers even with the bottom of the sucker feet for all other kinds of stock.

To set the paper levelers, loosen the locknut, shown in figure 13-15, and move the levelers to the required position in relation to the bottom of the sucker feet. Use a straightedge, as shown in figure 13-15, to ensure that they are properly and equally aligned.

Sucker Feet

The sucker feet and paper levelers are attached to a cam-operated bar that swings back and forth when the press is in operation. As the bar swings, it moves the feet down to pick up the sheet and up moving the sheet to the forwarding rollers where the suction cuts off to release the sheet. The paper levelers and sucker feet can be arranged on the bar in any order desired. There are 17 openings on the suction foot bar on the 385 model and 9 openings on the bar of the 9835 model.

Because of the number of openings, you can use any combination of positions necessary to cover the width of the paper stock being run. When you are not using all the sucker feet, you should seal the unused openings in the sucker-foot bar off with plugs. You will get better results if you use the maximum number of sucker feet necessary for each job. For example, if you are feeding 13-pound bond, you should install a sucker foot and then a paper leveler on each side of the center sucker foot. Follow with two sucker feet, then a paper leveler, and so on across the width of the paper. For narrow stock, unscrew the unused sucker feet with a 7/16-inch wrench and replace them with plugs. If you are feeding card stock, replace all the paper levelers with sucker feet. You should always try to have a sucker foot at each of the front corners of the stock.

Rubber tips are generally placed over the sucker feet to increase their pulling power. Brown rubber tips are available for use with heavy stock, and black rubber (neoprene) tips are used for other stocks.

The blower tubes that separate the top sheets on the paper pile are combined with the pile height regulator on the 9835 model offset duplicator. This aids the sucker feet in picking up the sheets and moving them into the forwarding rollers.

On the offset duplicator, Model 385, the blast is provided by the front blower tubes and also by the pile height regulator. Here the pile height regulator also acts as a blast pipe and a sheet separator finger. (See fig. 13-15.)

You can also regulate the amount of suction and blast with the blast or suction control knob. These knobs are found on the operator side panel of the press below the buckle control knob.

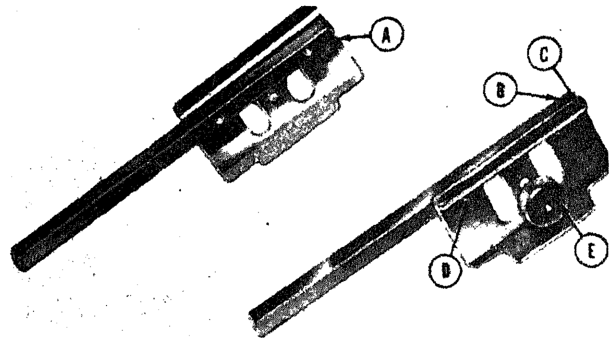
A clockwise turn increases the suction or blast, and a counterclockwise turn decreases either one. To set, turn each knob clockwise as far as it will go; then turn the knobs back one full turn counterclockwise. After you begin the run, you can increase the suction or blast setting, if necessary, by turning the knobs clockwise until the sheets separate and feed properly.

Forwarding Rollers

The forwarding rollers consist of a set of rubber rollers extended along a shaft. They are driven by a lower (knurled metal) forwarding roller located directly below the upper forwarding rollers.

The rollers drop against the sheet of paper just as it is released by the sucker feet and force it against the stops in such a manner that the sheet develops a slight buckle. They raise again to release the sheet just as the impression cylinder grippers close on the leading edge of the sheet.

In time, the forwarding rollers become worn and require replacement. To remove the forwarding roller unit, you simply loosen the screws at each end of the roller shaft and lift the unit from the press. Then you can slide the worn roller or rollers from the shaft, and then slide the new roller or rollers on to the shaft and replace the unit.



A. Side guide.
B. Side guide bar.
C. Guide plate.
D. Screws.
E. Knurled screw.

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Figure 13-16.—Left, the side guide arranged for left register; right, the side guide arranged for registering the sheet to the right side of the feed table.

Side Guides

Figure 13-16 shows the side guide setup for both the right and the left side register. To switch from one side to the other, remove the guide from the press by removing the knurled screw. Remove the screws and move the guide plate to the opposite side of the side guide bar. The word *Top* stamped in the side guide bar must be up when the guide is correctly assembled. With this change made, you can slide the bar to the opposite side of the press and lock the guide back on the bar with the knurled screw.

You should also reverse the position of the spring in the spring guide when you change the side guide from one side of the press to the other. To do this, you simply remove the screws which hold the spring in place; turn the spring so it is facing the opposite direction, and then replace the screws attaching the spring to the other side of the guide.

Sheet Detector Fingers

The sheet detector finger on this press is attached to a bar just beyond the forwarding rollers. When no sheet is fed through, this finger drops into a groove in a metal plate causing the cylinders to move out of contact with one another, tripping off the impression and the counter. This

Caliper

This press is not normally equipped with a caliper; however, calipers are available as optional attachments on some presses. The caliper actuates a solenoid which kicks off the feeder. This alerts the press operator that two or more sheets have gone through. They must be removed from the delivery unit and then feeder adjustments can be made, if necessary, before starting the sheets feeding again. You should set the caliper to allow one sheet to pass but to activate its solenoid if more sheets pass at once.

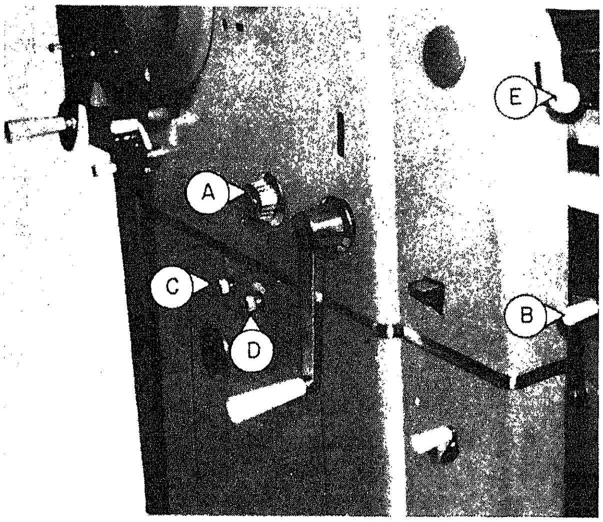
Buckle Control Knob

This press does not have front guides to stop the sheet just before it enters the printing unit. As the impression cylinder revolves, the cylinder grippers open to receive the sheet of paper. Just before the gripper opens, a set of metal plates (stops) rise to position the sheet in register. The forwarding rollers force the stock against these stops and the sheet is held with a slight buckle until the stops recede and the impression cylinder grippers close on the sheet as it moves forward.

If the sheet of paper does not develop a sufficient amount of buckle, the sheets may fail to deliver firmly against the paper stops and then the sheet will not enter the grippers fully. If there is too much buckle, the stock may be nicked along its leading edge by the stops. You can regulate the amount of buckle with the buckle control knob or the sucker feet dial, as shown in figure 13-17.

This knob changes the timing of the feeder by moving the sucker feet slightly forward or backward. (When it is set at zero, the sucker feet are set to strike the stock 1 inch from the lead edge of the sheet, for example, and as the knob is moved toward the high numbers, the sucker feet are set to strike the stack farther back toward the tail edge of the stock.) Moving the sucker feet forward causes them to deliver the sheet to the forwarding rollers sooner than before and produces more buckle, and moving them back delays delivery of the sheet and produces less buckle.

You should set this knob at 12 when you are running card stock and at 5 for regular stock. It may be necessary to move it to zero when you are running lightweight stocks. Since registration may be affected when the setting of the knob is changed, you should not change the setting during



A. Buckle control knob.
B. Pile height control lever. Set at 5 for average stock; use higher numbers for heavy stock and lower numbers for lightweight paper.
C. Blast control knob. Turn clockwise to increase blast.
D. Suction control knob. Turn clockwise to increase suction.
E. Paper feed lever. Raise to start the paper feeding.

113.326X

Figure 13-17.—Buckle, pile, feed, suction and blast controls.

Paper Feed Lever

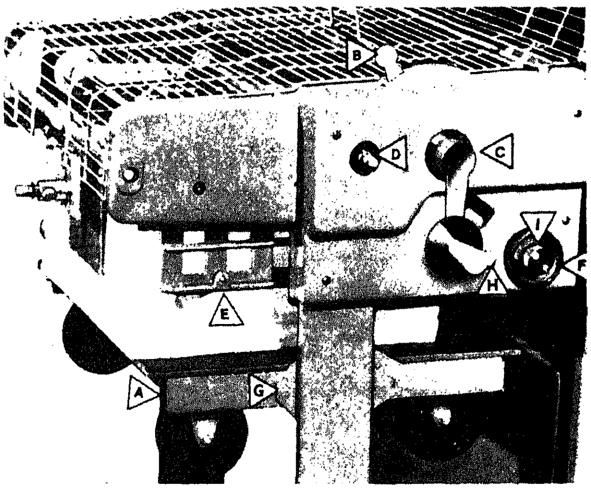
The paper feed lever is used for starting and stopping the feed of paper through the press. You must lift this lever up to start the sheets feeding through and push it down to stop the paper feed.

DELIVERY UNIT

The delivery unit on the offset duplicator, Model 9835, is similar to the Multilith 1360 offset press. Following the impression, the impression cylinder grippers open to release the sheet of paper. Ejector fingers then raise to lift the edge of the paper away from the impression cylinder and move the sheet over a set of stripper fingers. The stripper fingers strip the sheet from the impression cylinder and direct it under two ejector rollers which force the sheet into the paper receiver tray.

CHAIN DELIVERY

The offset duplicator, Model 385, comes equipped with a chain delivery, as shown in figure 13-18.



A. Delivery platform (dolly).
B. Receding control lever. Push to zero to stop the platform from receding. Move to the position marked "raise" when moving empty platform into receiving position.
C. Crank for raising and lowering platform manually. Turn clockwise to raise.
D. Shaft. Transfer crank (C) to this shaft to raise platform fast.
E. Side jogger.
F. Knob used for moving back jogger forward or backward.
G. Yoke.
H. Side jogger crank. Moves side jogger in or out sidewise. There is one on both sides of the press.
I. Locknut for knob (F).

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Figure 13-18.—Delivery controls.

Delivery Board

On the offset duplicators, Model 385, you can lower the delivery platform (dolly) with its stack of printed sheets manually by turning the crank clockwise for raising and counterclockwise for lowering. (See fig. 13-18.) After you remove the dolly from the press, slide a new dolly into the yoke. The swivel wheels of the dolly should be positioned towards the press.

With the dolly in position, move the receding control lever to the position marked RAISE and turn the crank clockwise to raise the dolly. If you wish to raise the dolly fast, transfer the crank to the other shaft which is geared for faster movement. Raise the dolly until it touches the side jogger.

After this, you can set the receding control lever to lower the stack automatically as the stock is being run. The lowering rate for 20-pound bond should be at the mark between 0.002 inch and 0.006 inch. Move the receding control lever to 0.002 inch for thin stock and to 0.024 inch for heavy or bulky stocks.

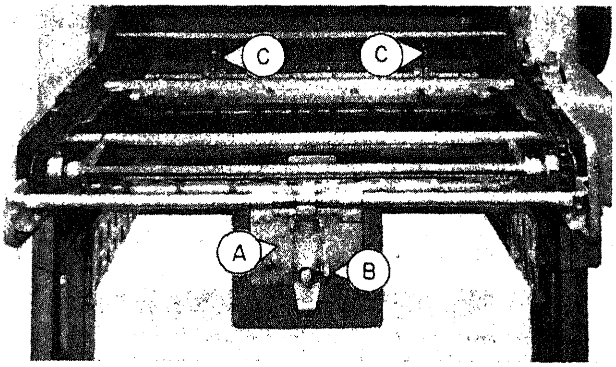
Setting the Joggers and Delivery Reels

To set the joggers on the Model 385 offset duplicator, flip the vacuum switch on and lift the paper feed lever. Then rotate the press by hand with the handwheel to feed a sheet through the printing unit. Continue to turn the handwheel until the sheet is released on the delivery board and one delivery gripper bar is directly over the other one.

Use the side jogger cranks on each side of the press to move the side joggers until they are even with the edge of the sheet. Next, move the back jogger up against the tail edge of the sheet by loosening the locknut and turning the knob used for moving the back jogger forward or backward as much as necessary. Retighten the locknut to hold the back jogger in position. Next, loosen the knurled lock screw shown in figure 13-19, and move the paper stop against the gripper edge of the sheet.

Slide the delivery reels sidewise to adjust for the paper width. Try to set them to run in a non-image area, if possible, so that they will not smear the ink on the sheet. You can remove the reels with a flip latch, if necessary. When reinstalling them, make sure the locating pins are squarely seated in the shaft keyway.

Feed two or three sheets through the press manually to check the setting of the joggers and the delivery reels. Reset them if they bind on the paper and cause it to buckle. When you adjust the paper stock properly, the paper stop will not bounce as the sheets are delivered.



A. **Paper stop.**
B. **Lock screw for paper stop (A).**
C. **Delivery reels.**

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Figure 13-19.—The delivery reels and the paper stop.

SPEED CONTROL

The Model 9835 offset duplicator has an operating speed range of 4,500 to 9,000 impressions per hour, while the Model 385 offset duplicator has an operating speed range of 5,000 to 8,000 impressions per hour.

You can increase or reduce the operating speed of the press by turning the speed control (crank) on the operator side of the press below the motor and vacuum switches. You should change the speed of the press with this crank only when the press is running.

It is also recommended that new press operators use minimal press operation speed until they become more accustomed to the press. Minimum press operation speed should also be used when you are washing up (cleaning) the ink roller.

The 9835 model has a display speed button on the control panel. When you depress this button, the press speed will be displayed on the (speed) indicator for 10 seconds.

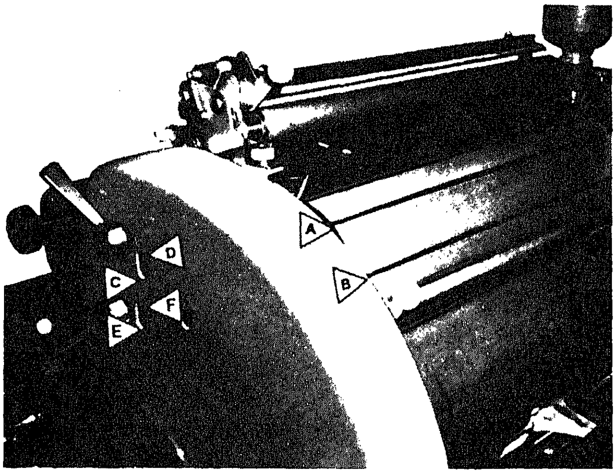
PRESS ADJUSTMENTS

The following paragraphs describe some of the more common adjustments for the A. B. Dick Model 385 Offset Duplicator. The Model 9835 offset duplicator is similar in most adjustments with only minor differences and therefore need not be repeated. Of course, an operator should always use the operator's manual supplied by the manufacturer of the press when making any adjustment.

Form Roller Adjustment

The form rollers should turn freely on their shafts and should not be set to bear heavily against the plate. A heavy setting or a roller that does not turn freely may cause a non-printing streak to appear near the gripper edge in the image area. Form rollers that are too tight or have too much end play can wear the image off the plate in as few as 1,000 impressions. You should check the form roller setting at regular intervals.

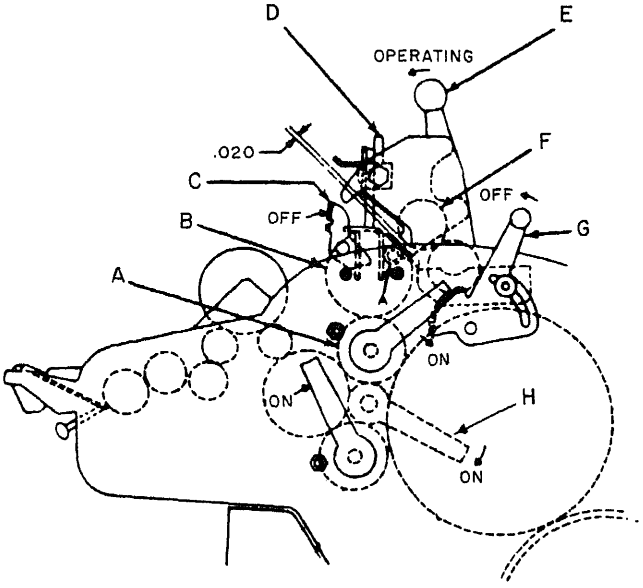
To check the form roller setting, you should mount a used plate on the press and ink up the



A. Inked stripe left by the lower form roller.
B. Inked stripe left by the upper form roller.
C. Lock screw.
D. Upper form roller adjusting screw (eccentric).
E. Lock screw.
F. Lower form roller adjusting screw (eccentric).

113.335X

Figure 13-20.—Form roller adjusting screws.



A. Upper form roller.
B. Aquamatic oscillator roller.
C. Water ductor lockout.
D. Aquamatic oscillator night latches.
E. Aquamatic ductor night latch lever.
F. Aquamatic ductor roller.
G. Water control lever.
H. Form roller night latch lever.

113.337X

Figure 13-21.—Adjusting screws for paralleling the aquamatic ductor to the oscillating roller.

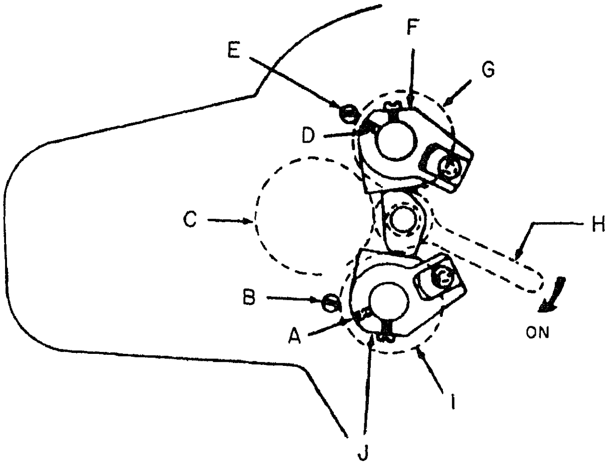
rollers. Then stop the press and drop the rollers against the dry plate. Raise the rollers and rotate the plate cylinder with the handwheel until the inked stripes left by the rollers on the plate come into view. (See fig. 13-20.) The upper ink stripe shown in the illustration was created by the lower form roller, and the lower stripe was created by the upper form roller. The stripe left by the lower form roller should be five thirty-seconds inch to three-sixteenths inch wide, and the upper form roller should create a stripe one-eighth inch to five thirty-seconds inch wide. Both stripes should be of the same width from one end of the stripe to the other.

If you need to make an adjustment, loosen the lock screw and adjust the adjusting (eccentric) screw to change the pressure on the form roller needing the adjustment. There is a similar set of adjusting screws on the far side of the press, and you should adjust both ends of the roller if necessary. Turning the adjusting (eccentric) screws toward the feed table will increase the pressure and create a wider stripe, and turning them in the opposite direction will reduce the width of the stripe. Tighten the lock screws after the adjustments are made and drop the rollers on a different part of the plate to see if your adjustment has created the correct stripe width. If it did not, repeat the adjustment process until the stripes are the correct width.

Aquamatic Ductor Roller

To check the setting of the aquamatic ductor roller, you should move it against the aquamatic oscillator; then move it back (out of contact) and examine the line left on the oscillator. If the aquamatic ductor roller is not parallel with the aquamatic oscillator, it may cause the plate to pick up ink in the non-image areas (toning) on one side of the plate. Before attempting to parallel the two rollers, you should ensure that the ink form rollers are properly adjusted. Then move the form roller night latch lever to the on position and lower the aquamatic oscillator roller with its night latch shown in figure 13-21.

Drop the upper form roller and move the water control lever to its off position. Put the aquamatic night latch lever in the operating



A. **Setscrew.**
B. **Eccentric screw.**
C. **Oscillating roller.**
D. **Setscrew.**
E. **Eccentric screw.**
F. **Form roller lever.**
G. **Upper form roller.**
H. **Night latch lever.**
I. **Lower form roller.**
J. **Form roller lever.**

113.336X

Figure 13-22.—Night latch eccentric screw adjustment.

position, and move the water ductor lock out to its off position.

Turn the press using the handwheel to move the aquamatic ductor roller all the way in toward the aquamatic oscillating roller. There should be 0.02 inch clearance between the two rollers at this point. If adjustment is necessary, loosen the locknut and adjust the eccentric stud for the aquamatic ductor roller until you obtain the proper clearance. Then retighten the locknut.

End Play

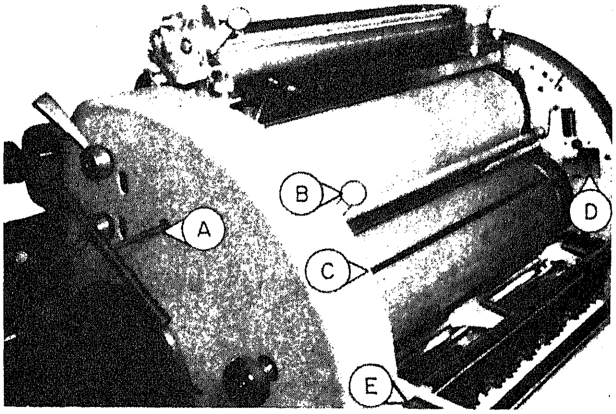
You can check for end play in the rollers by moving the night latch lever, shown in figure 13-22, down to the on or night latch position and dropping the form rollers. Check to see that the rollers turn freely with no more than 0.005 inch to 0.010 inch end play. If there is too much end play, loosen the setscrews in the form roller levers on the far side of the press and adjust the sleeves to produce the correct amount of end play. Then tighten the setscrews again before rotating the press.

The two form roller levers shown in figure 13-22 must not contact their eccentric screws when the form rollers are down. Also, there must be no contact between the two form rollers and the oscillating roller when the form rollers are in the on or night latch position.

If you need to make an adjustment to the night latch, push the night latch lever down and adjust the eccentric screws in each form roller until there is no contact between the oscillator and the roller. Move the night latch lever up again and turn the form roller levers to the on position. Check to see that there is a clearance between the eccentric screws and the form roller levers. If there is contact, further adjustment to eccentric screws will be needed. To do the additional adjustment, repeat the steps just described.

Cylinder Adjustments

To parallel the plate and blanket cylinders, you should mount an old plate on the press and ink the plate solid. Stop the press, and then rotate it



A. **T-wrench.**
B. **Image control lever. Push down and turn T-wrench clockwise to bring the plate and blanket cylinders into contact.**
C. **Stripe produced on blanket by inked plate.**
D. **Adjusting screw. Turn counterclockwise if stripe (C) is too heavy and vice versa. There is an adjusting screw on both sides of the cylinder.**
E. **Counter.**

113.338X

Figure 13-23.—Adjusting the pressure between the plate and blanket cylinders. Set for a light 1/8″ stripe on the blanket if you tend to get dot squeeze with the 5/32″ stripe recommended in the text.

manually with the handwheel until the plate cylinder gap is facing the feed table.

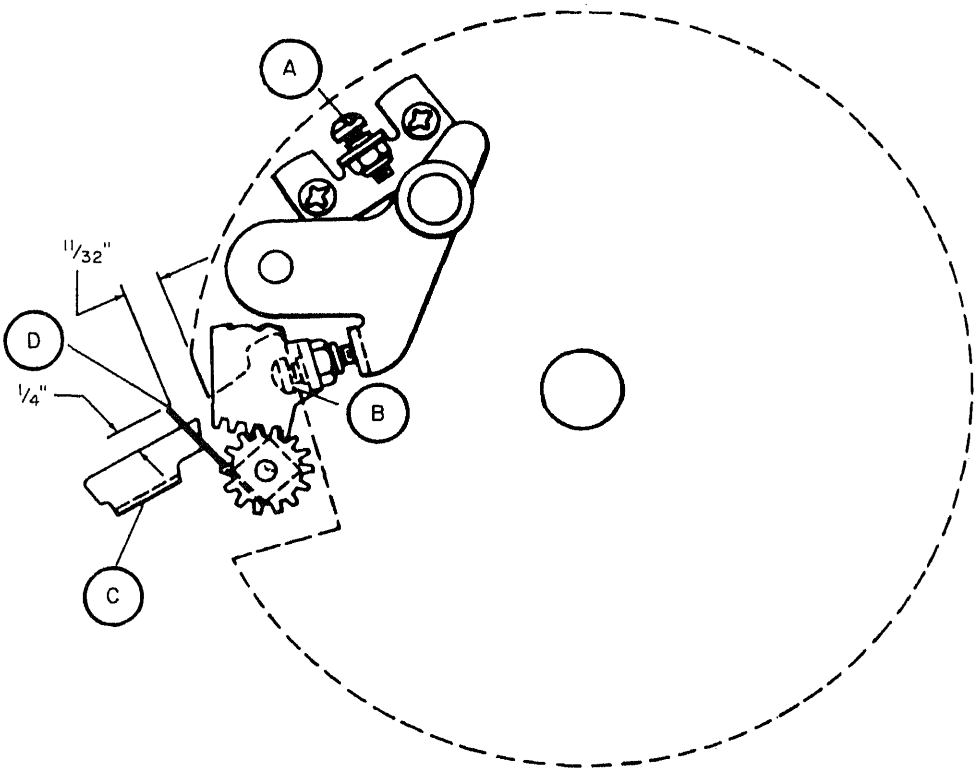
Insert the T-wrench through the hole in the side of the press and into the plate cylinder shaft, as shown in figure 13-23. Push the image control lever down and hold it while you turn the T-wrench clockwise. When you feel the plate cylinder contact the blanket cylinder, release the image control lever and continue to turn the T-wrench until the plate cylinder unlatches or breaks contact with the blanket cylinder. This will transfer a stripe of ink onto the blanket.

Next, remove the T-wrench and rotate the press until the inked stripe produced when the blanket contacted the plate cylinder comes into view. This stripe should be five thirty-seconds inch wide and even in width from end-to-end. If the stripe is too wide, turn the adjusting screws on each side of the press clockwise. If the stripe is too narrow, turn the adjusting screws counterclockwise. Use the T-wrench to bring the two cylinders together again and check the new ink stripe. Repeat this process until you obtain a stripe of the correct width.

Cylinder Gripper Adjustment

Figure 13-24 shows the adjusting screws used in regulating the gripper tension and the distance the grippers open. Both of these screws are located on the near or operator's side of the press on the impression cylinder, just inside the press frame.

To adjust the tension on the grippers, you should turn the handwheel until the grippers start to open to receive the paper from the stops. Then place a sheet of paper (over the forwarding rollers) with the front edge of the stock against the stops. Turn the handwheel until the paper is gripped and just ready to be drawn into the printing unit. Then adjust the screw used in adjusting tension until



A. Screw used in adjusting tension on grippers.
B. Screw that regulates distance grippers open.
C. Stripper assembly.
D. Gripper.

57.332X

Figure 13-24.—Impression cylinder gripper adjustments.

equired to remove the paper from
counterclockwise turn of this screw
pressure and a clockwise turn
pressure.
es are that it will not be necessary
urb the setting of the screw which
istance the grippers open. However,
at they are not opening the proper
ome reason, you should turn the
e handwheel, until the grippers are
an inch above the stripper assembly
y end of the press. Then adjust
hich regulates the distance the
until the gripper tips are eleven
of an inch above the edge of the
the grippers are open.
stments will not be covered in this
her adjustments are needed, refer
acturer's operator's manuals or the
nual for the A. B. Dick Model 385
B. Dick Model 9835.

EP OPERATIONS

beginning of the day or at regular
n and lubricate the press.
e end of the drain tube into the
event the fountain solution from
fill the aquamatic fountain bottle
solution, and position it in the

e both form rollers are raised, and
ress manually for one or two
dampen the ductor roller.
the aquamatic night latch lever
the feeder end of the press to stop
the ductor toward the ink rollers.
ut dropping the ink form rollers, fill
ain and turn the fountain roller
stribute the ink. Set the ink control
te the press to bring the ink ductor
the fountain roller.
the ink fountain control to its No.
en with the aquamatic control knob
uamatic night latch lever in its up
on the press and set it at the
ating speed. Run the press and
fountain setting as necessary. Once
f ink and fountain solution are
the press.
Most press operators start by
e water rollers before distributing
ver, some prefer to ink the rollers

7. Set the feeder. Move the piling guides to a point along the scale that corresponds to the width of the paper stock being run.

8. Set the paper support beams so that they will clear the back stop, side guide, side guide spring, and paper height regulators when the feed table rises, as the last sheets are fed into the press.

9. Lower the feed table and load the stock.

10. Raise the feed table until the top sheet in the pile contacts the pile height regulators when the regulators are in their lowest position.

11. Set the back stop and two side guides against the back and sides of the stack. The spring guide should be placed on the left side if you are registering the sheets to the right and vice versa. Reverse the spring when changing from one side to the other.

12. Adjust the paper weight (bail) if necessary for the type of stock being run.

13. Position the sucker feet, if necessary. Attach rubber tips to the feet according to the type of stock being run.

14. Turn on the vacuum pump switch and lift the paper feed lever. Then turn the press manually to feed a sheet through to the delivery board. Set the joggers for the size of the sheet.

15. Adjust the impression cylinder, if necessary, to allow for the thickness of the stock to be run.

16. Mount the plate on the cylinder. Sponge the plate and start the press in operation. Move the aquamatic control lever to No. 5 and the ink control lever to No. 2. (This setting will vary according to the type of stock, the press speed, etc.)

17. Turn on the press and the vacuum pump motors and move the aquamatic night latch lever to its up or operating position. Move the aquamatic lockout latch away from the ink fountain, momentarily, to allow a little moisture to accumulate on the water rollers.

18. Drop the upper form roller first; then drop the lower form roller. Watch the plate to see that it does not pick up ink in the non-image areas. If it does, you are operating with too much ink or too little water.

19. Push the image control lever down for two or three revolutions of the press. Pull it up again when a good image appears on the blanket.

20. Raise the paper feed lever to feed one

21. After the first sheet feeds through, lower the paper feed lever to stop the sheets from feeding. Raise the form rollers. Check for position of the image on the sheet.

a. If the image is not centered sidewise, move the paper stack or release the plate from the head and tail clamps and make a small lateral adjustment (up to one-fourth inch) by shifting the plate sidewise.

b. If the image is not straight on the paper, release the plate from the tail clamp and turn the angular adjusting knob to twist the head clamp on the plate cylinder.

c. If the image is too high or too low, rotate the impression cylinder to change the position of the grippers in relation to the image on the blanket.

22. Adjust the buckle control knob, if necessary, to provide the proper buckle in the stock.

23. Start the press and pull another impression. Check for proper image position, image quality, and low spots that are not printing properly. Adjust the ink and fountain solution distribution, if necessary, to improve image quality. Change the blanket or underlay low areas of the blanket with strips of paper, if necessary.

24. Set the counter at 00000, sponge the plate, and begin the pressrun.

25. Examine the work at regular intervals by lifting the paper stop at the delivery and removing a press sheet.

26. Watch the ink distribution. Adjust the ink and fountain solution as necessary. The numbers next to the aquamatic control lever correspond to those on the fountain keys, and you can use them as a guide in attaining the correct distribution. Adjust the overall feed with the ink fountain control lever. Moving it toward No. 8 increases the ink feed and vice versa. It may be necessary to increase the ink and fountain solution feed if you increase the speed of the press. Humidity, paper stock, and driers also affect these settings.

27. Reload the feeder as stock is depleted. Remove stock from the delivery unit when necessary.

28. When the pressrun is completed, move the paper feed lever to the off position and raise the form rollers. Turn the fountain solution and ink controls to off and move the aquamatic ductor control lever to the night latch position. Then shut off the press motor and the vacuum pump.

29. If the plate is to be saved, remove the excess ink from the image by running four to six sheets of paper through the press with the ink rollers raised. Then stop the press, remove the plate, and transfer it to a table. Now coat the plate with gum arabic or other preservative, according to the plate manufacturer's instructions.

30. Rotate the press and clean the blanket with a rag dampened with solvent and dry it with a clean rag.

31. Prepare the press for the next job.

WASHUP AND SECURING

At the end of the day, you should move the aquamatic night latch lever to the on or night latch position. Remove the fountain solution bottle and drain the fountain by removing the end of the drain tube from the bracket.

Remove as much ink from the ink fountain as possible. Then remove the ink fountain from the press by turning it, as shown in figure 13-25, and lifting it up. Use a clean cloth dampened with solvent to clean the remaining ink from the ink fountain. A clean cloth dampened with solvent is also used to clean the ink fountain roller. After this, start the machine and run it at its slowest

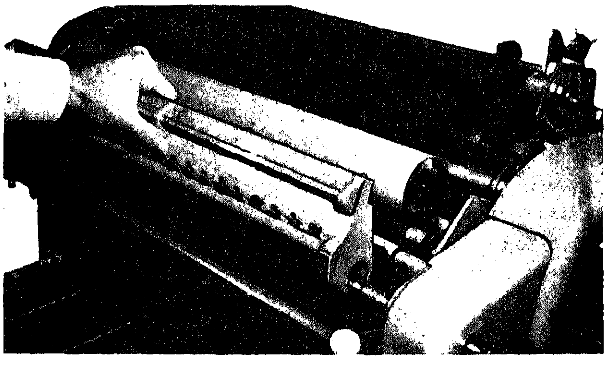


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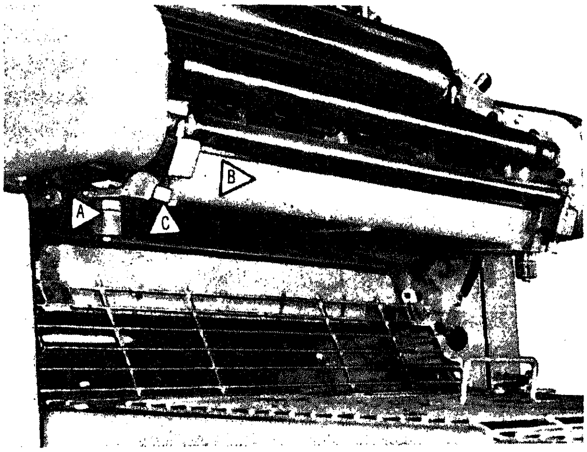
Figure 13-25.—Removing the ink fountain from the press.



A. Knurled nuts used to move the wash-up attachment into or out of contact with the ink rollers.
B. Wash-up attachment.
C. Locks.

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Figure 13-26.—Wash-up attachment (with the ink fountain removed from the press).

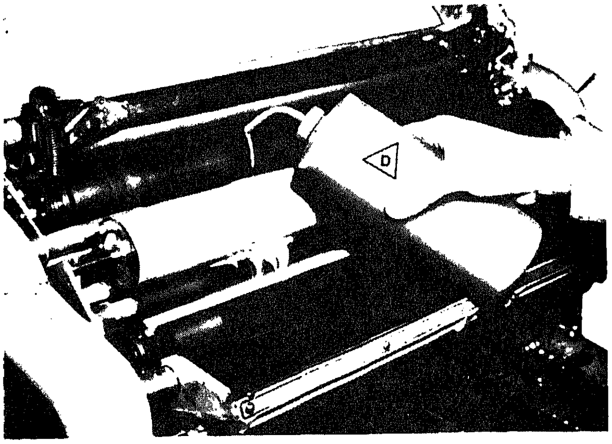

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Figure 13-27.—To prevent the rollers from skidding, clean only one side at a time.

speed. Turn the knurled nuts, shown in figure 13-26, to move the wash-up attachment against the ink rollers.

Use a small container filled with solvent and squirt a small amount of the solvent over one-half of the oscillating roller, as shown in figure 13-27. (If you try to clean the entire rollers, the solvent may lubricate the rollers and cause them to skid.) After the solvent has worked into and cleaned this half of the rollers, you should clean the other half of the rollers in the same manner. When the rollers look clean, shut off the press and go over the ends of the rollers with a clean cloth dampened with solvent to clean off any ink remaining on them. Loosen the knurled nuts when the rollers are clean to move the wash-up attachment away from the rollers. (See fig. 13-26.)

When the wash-up attachment has been used, you should remove and clean it before the ink dries and becomes hard. To remove the attachment, loosen the knurled nuts until you can push the nuts and toggles out of the mounting slots in the trough of the wash-up attachment. Depress and rotate the locks until they drop down; then turn the trough back and slip it off the ends of the roller. Clean the trough and blade with a cloth and solvent.

If it is necessary to remove the aquamatic fountain tray for cleaning, remove the knurled nut at each end and lift the tray out, as shown in figure 13-28. Clean the aquamatic ductor roller with a chrome cleaner and then coat it with fountain solution.

You should also clean and coat the impression cylinder surface with fountain solution. You can reach the cylinder surface from the delivery end of the press. In order to do a thorough cleaning job, it may be necessary for you to slide the disks on the skeleton cylinder sidewise during this operation. You can slide the disks to the left when you clean the right side of the cylinder and slide them to the right when you clean the left side. Finally, you should go over the blanket with blanket wash and then wipe it dry. With all cleaning completed, you can now put on the night

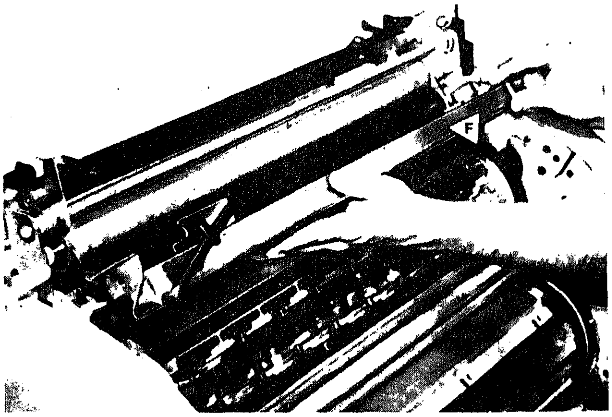

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Figure 13-28.—Removing the aquamatic tray for cleaning.

latches to relieve tension on the rollers and prevent their developing flat areas.

On the A. B. Dick Model 9835, the cleanup operation is similar except that you will have to use cleaner sheets instead of an ink wash-up attachment.

SAFETY GUARDS

Both presses are equipped with several safety guards. The safety guards are connected to a switch that turns off the press motor so that the press will stop or not operate when a guard is lifted. To start the press again after a guard has been lifted, you must return the guard to the closed position. Then turn the motor switch to its off position, and then turn it on again. You should not get into the habit of using the guard instead of the motor switch to stop the press.

Keep cloth material and tools off the safety guards. Keep your hands clear of the chains and gripper bars at all times. To remove a press sheet for inspection during the run, lift the hinged paper stop and catch the sheet; do not reach inside the guard. Remember safety first, last, and always.

PRESS MAINTENANCE

If the equipment in your shop includes an A. B. Dick press, detailed lubrication and maintenance procedures are included in the shop's planned maintenance system (PMS) covered by OPNAVINST 4790.4A, *Ships' Maintenance and Material Management (3-M) Manual*. In general, you should oil anywhere that one moving part contacts another. As you lubricate the press, wipe up any excess oil or grease with a rag, because paper dust (lint) and dirt tends to accumulate heavily in these areas. Rotate the press with the handwheel to reach hard-to-get-to places. Never oil a press while it is running.

In addition to proper lubrication, an equally important part of any maintenance program is equipment cleanliness. Ensure that the press you are operating is kept clean. Clean equipment will aid greatly in producing quality printing jobs and prolong the life of the press. Press cleanliness includes such things as proper roller care to prevent glazing, frequent wiping of the cylinders with a rag to prevent ink build-ups that may cause uneven printing pressures, and attention to feeder and delivery components that may transfer ink or dirt markings to the press sheets.

Whenever you are maintaining a press, it's important that you know the equipment. If you are in doubt as to the cause of a particular press trouble, get advice before you become "wrench happy." In many cases costly repair jobs to equipment can be avoided by having qualified personnel make adjustments and repairs. It's too late to ask for help once the damage has been done.

SUMMARY

This chapter introduced you to the A. B. Dick Offset Duplicators, Models 385 and 9835, and gave you the maximum and minimum image and sheet size with a brief description of the differences between their duplicators and other types of presses.

The operator controls for the 385 model were covered giving a brief description of the on/off switch, vacuum control, ink form roller handles, feeder latch, and night latches. The 9835 model is similar in operation with the exception of the operator control lever and the control panel. The control panel has a clear and a recall button, counter, display speed indicator button, feed, on/off motor and pump buttons, jam indicator, doubles-sheet indicator, safety covers, and paper-low indicator displays. Each of these were covered for operation and location.

As for the inking units of both presses, each operates with a similar number of ink rollers, supplying ink to the plate. The inking system operates in tandum with the aquamatic system. Contact between a fountain roller, a ductor roller, and a oscillator roller carries fountain solution into the inking system.

The blanket cylinder is similar to others discussed in previous chapters. It transfers the image from the plate onto the paper being printed. Changing the blanket was discussed along with its proper care.

The plate cylinder carries the offset plate. Image adjustments that can be made prior to running the job were discussed.

The automatic feeder on these two models of duplicators do not have a register board as other presses do. The paper is fed in and controlled by the amount of buckle you have on your stock as it reaches the stops just before the sheet enters the grippers.

The delivery unit may be either chain delivery or be a jogging paper tray. The chain delivery has a receiving stacker, side jogger, and a delivery platform, while the paper tray does not recede and may or may not have the joggers.

To change the operating speed of both duplicators, you must turn a handle. The operating speed of the 9835 model will be displayed on the control panel when you push the display speed button.

Various press adjustments were explained, but always check with your supervisor prior to making adjustments. Being "tool happy" can do more harm than good. Operation of the press from start-up to washup and securing were covered. Ensure that all steps are well known prior to operating the press. Safety of operation during all operating procedures is essential. Avoiding a safety procedure or safety guard is a surefire method of causing either personal injury or equipment damage. Along with safety goes proper maintenance. For long productive press life with top quality, you must have safety and maintenance. Larger offset presses will be discussed in the next chapter.

CHAPTER 14

THE 19- BY 25-INCH HARRIS OFFSET PRESS

A designated section of this chapter contains information required for LI1 and LIC candidates only. This section will be prefaced with "For LI1 and LIC Candidates Only." LI3 and LI2 candidates DO NOT have to read the designated section. However, junior LIs serving as LPOs may find the information of interest.

The Harris offset presses are built in a variety of sizes (see fig. 14-1). However, this rate training manual will cover only the 19- by 25-inch model 125C, single-color offset press.

This press will print a press sheet as large as 19 inches by 25 inches or as small as 8 1/2 inches by 11 inches (see fig. 14-1).

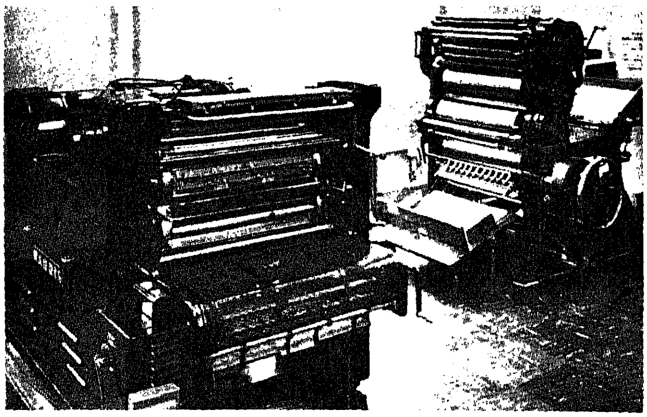

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Figure 14-1.—At right is the first Harris offset press that was built in 1906. It was sold to a company in Pittsburgh, Pennsylvania, where it was operated for 35 years before it was finally returned to the Harris Corporation to be used for display purposes in their New York headquarters. In 1966, it was presented to the Smithsonian Institution in Washington, D.C.

OPERATING PRINCIPLES

Basically, this press consists of a stream feeder, a conveyor tape table (feedboard), a registering unit (at the end of the tape table), a printing unit, and a delivery unit.

An impression lever (called the feeder latch lever) is used to set the feeder and registering mechanisms in motion and to put the press on impression. The press operator moves this lever to the left (toward the delivery end of the press) to the first notch to set the feeder and registering mechanism in motion; and then moves it all the way to the left to the second notch to throw on the impression.

Although the feeder is set in motion when the feeder latch lever is moved into the first notch, the sheets do not start moving down the tape table until the air and vacuum are turned on.

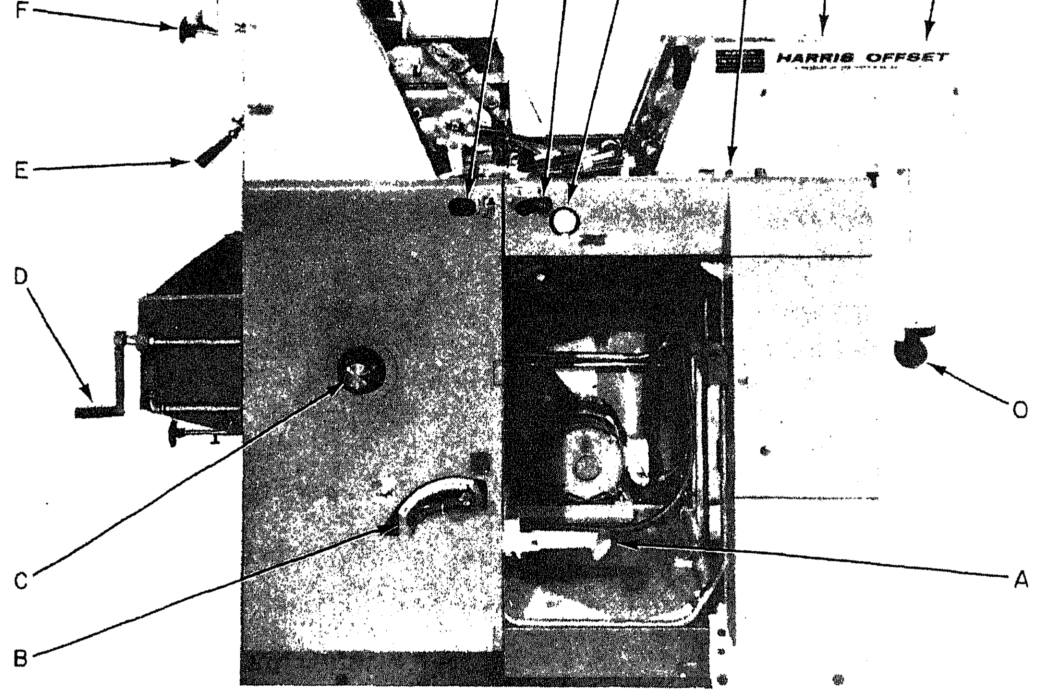
When the press operator moves the lever to the first notch and turns on the air and vacuum, two sucker feet, located in the separator unit at the back of the pile, drop down to pick up the top sheet. As they start to lift the sheet, a pressure foot drops down against the second sheet in the pile to keep it from being picked up.

The pickup suckers lift the sheet into contact with another set of suckers (called the forwarding suckers), and the sheet is held momentarily by both sets of suckers. The pickup suckers then release the sheet and the two forwarding suckers move it toward the tape table. At this point a blast of air from the blower tubes at the back of the stack floats the top sheet, separating it for its entire length from the rest of the pile.

As the forwarding suckers move the sheet forward, two metal plates (known as flaps) at the front of the pile, tilt forward and act as a ramp to direct the sheet onto the tape table and under a pair of pull-in wheels (forwarding rollers).

When the gripper (front) edge of the sheet is approximately one-fourth inch under the forwarding rollers, the vacuum cuts off and the forwarding suckers release the sheet.

The forwarding rollers force the sheet onto the conveyor tapes which carry it down the tape table to the registering mechanism. As the sheet travels down the tape table, it passes under a caliper and



A. Foot pedal. Step on this pedal to shift press from idling to operating speed.
B. Variable speed control. Set handle along scale to operating speed desired.
C. Drive shaft. You can insert a detachable handle through a hole in the end of the drive shaft to turn the press manually.
D. Handle for raising or lowering the delivery platform manually.
E. Ink throw-off handle. Pull out and turn to hold pin out of slot to stop automatic lowering and raising of form rollers.
F. Ductor roller control (may be a star wheel, as shown here, or a T-handle, as shown in figure 14-36).
G. Handle for turning ink fountain roller by hand.
H. Knob used for adjusting side guide while the press is running.
I. Handle for moving dampener rollers to or from the plate.
J. Feeder latch lever. Push toward the delivery end of the press to throw on the impression; push toward feeder end to throw impression off.
K. Oil pressure gauge.
L. Starting and stopping control panel.
M. Separator unit (hidden).
N. Handle for raising and lowering feed table manually (hidden).
O. Feed table. It consists of a detachable dolly.

113.346X

Figure 14-2.—The near side of a 19- by 25-inch Harris offset press.

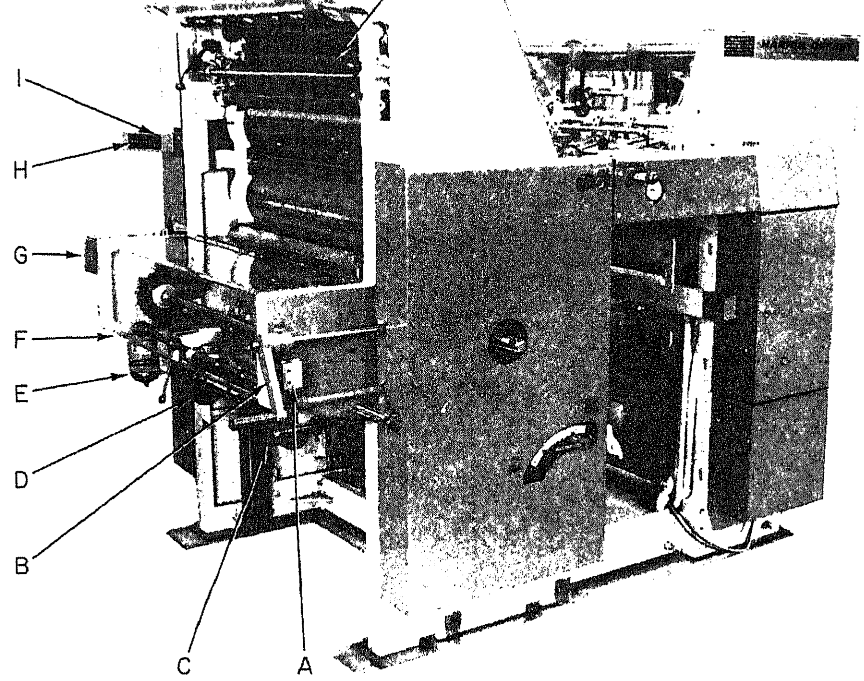
a set of wheels and brushes that are used to control its movement.

> NOTE: As the second and consecutive sheets are moved onto the conveyor-tape table they form a "stream." This stream of overlapping sheets is the reason why the feeder of this press is referred to as a stream feeder.

When the gripper edge of the sheet is even with the side guide (register unit), the press operator shoves the feeder latch lever into its second position to throw on the impression.

As the sheet nears the end of the tape table, a set of front guides lower to intercept it and an electrically operated sheet detector lowers to detect the presence of the sheet.

While the front guides are holding the sheet, a sheet flattening bar (called a corrugating bar)



A. Switch which allows table to lower automatically when handle (B) is pulled out.
B. Handle for raising and lowering delivery board.
C. Knob used for moving rear jogger.
D. Delivery board (dolly).
E. Spray.
F. Plastic guard.
G. Delivery end control panel.
H. Counter.
I. Trip button. For tripping off impression from delivery end of press.
J. Handle for turning ink form roller manually.
K. Ductor roller control.
L. Handle for raising and lowering ink form rollers manually.
M. Handle for moving dampener rollers to or from plate.

113.347X

Figure 14-3.—Delivery end of the press.

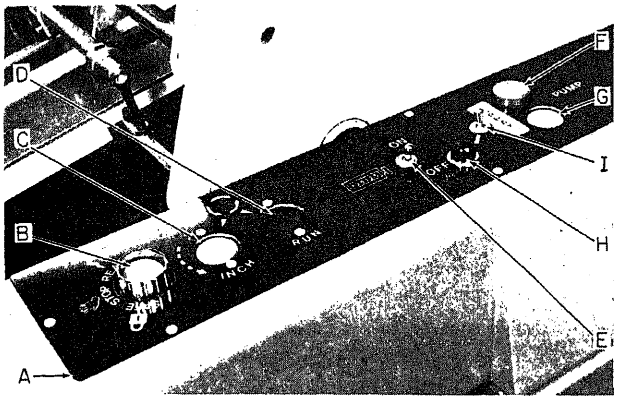
lowers against the sheet to hold it steady. Then the side guide moves in against the side of the sheet and pushes it approximately three-sixteenths inch sidewise and into register.

When the side guide stops, the impression cylinder grippers close on the lead edge of the sheet, the front guides, and corrugating bar lift. The impression cylinder grippers start to pull the sheet into the printing unit and the side guide returns to its original position.

As the sheet is carried around the impression cylinder, it receives the impression. When the press sheet emerges from the printing unit, a set of delivery grippers attached to a traveling gripper bar closes on it. The impression cylinder grippers and the delivery grippers are both closed on the sheet for approximately one-fourth inch of cylinder travel. The impression cylinder grippers then open to release the sheet, and the delivery grippers carry it down around a skeleton cylinder and out to the delivery pile. The sheet is then released, to stack with its printed side up. The pile is kept uniform by joggers, and the delivery table lowers automatically as the stock is delivered.

STARTING AND STOPPING

This offset press has three control panels from which it can be operated. The main control panel is located on the casement of the near side of the tape table. (See fig. 14-2.) There is also a control panel at the delivery end of the press and one located under the press (fig. 14-3).



A. Control panel.
B. Stop button with safety device.
C. Inch button.
D. Start button.
E. Switch for starting and stopping the operation of the counter.
F. Start button for the vacuum pump.
G. Stop button for the vacuum pump.
H. Indicator light. Glows when counter is not operating.
I. Toggle switch for offset spray.

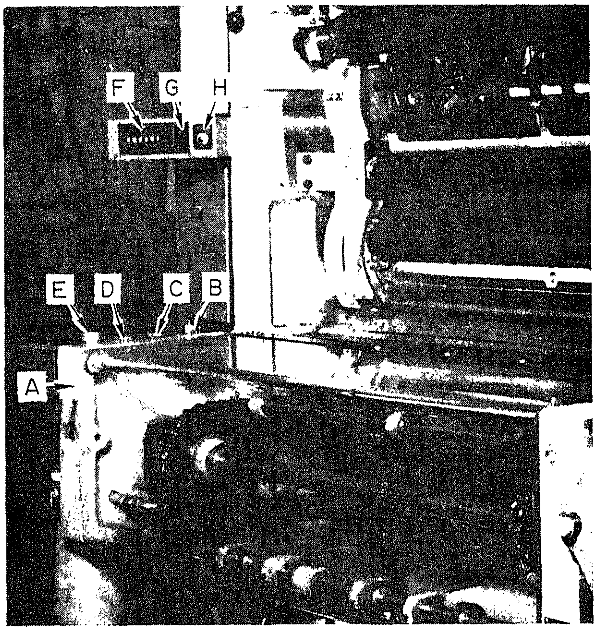
113.348X

Figure 14-4.—Control panel located on near side of press.

A close-up of the main control panel is shown in figure 14-4. As you can see in the illustration, it contains buttons for starting and stopping the press, inching the press, starting and stopping the vacuum pump, and starting and stopping the counter. (There are three positions marked on the stop button: SAFE, STOP, and READY. You should turn it to the position marked SAFE when the press is shut down for any length of time.) In addition, you will find a switch for turning the offset spray off and on and an indicator light for the counter. This light will glow when the counter is inoperative. To make the press run continuously, you must push the inch button and the start button at the same time.

Press operators generally shut off the air and vacuum first when stopping the press. This stops the paper feed. The ink and impression pressure will then trip off automatically after the last sheet has gone through. The dampening or water rollers must be raised or lowered by hand, of course, since they do not function automatically.

A close-up view of the delivery control panel is shown in figure 14-5. There are buttons for starting and stopping the press, for inching it, and for inching it in reverse.

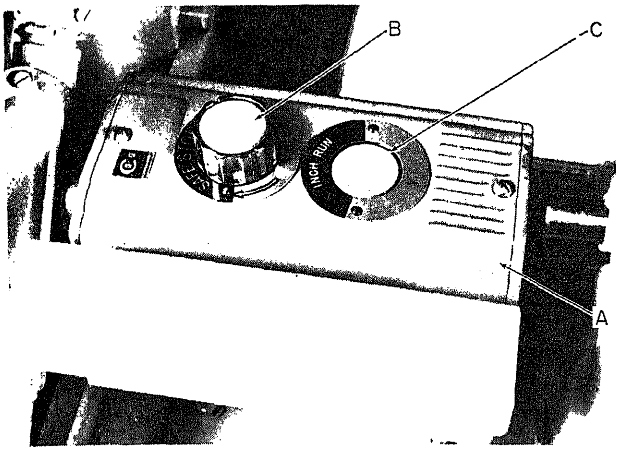


A. Control panel.
B. Button for stopping the press.
C. Button for inching the press.
D. Button for starting the press.
E. Button for inching the press in reverse.
F. Counter.
G. Reset wheel for counter.
H. Trip button used in tripping off impression from delivery end.

113.349

Figure 14-5.—Control panel located at delivery end of press.

The control panel shown in figure 14-6 is located under the tape table feedboard just above the press base. It has a stop button similar to the one on the main control panel and an inching button. You can use it when you are working under the tape table or when you are cleaning the impression cylinder or adjusting the cams. When the stop button under the press is moved to SAFE, you can inch the press from under the tape table, but the press cannot be inched or rotated from any of the other control panels. This is for the protection of the person working under the feedboard in case someone else happens to be working around the press. You must always move the stop button back to the READY position when you are through working under the tape table, of course. Otherwise, the press will not operate.



A. Control panel.
B. Button for stopping the press (with safety device).
C. Button for inching the press.

113.350X

Figure 14-6.—Control panel located underneath the press.

SPEED CONTROL

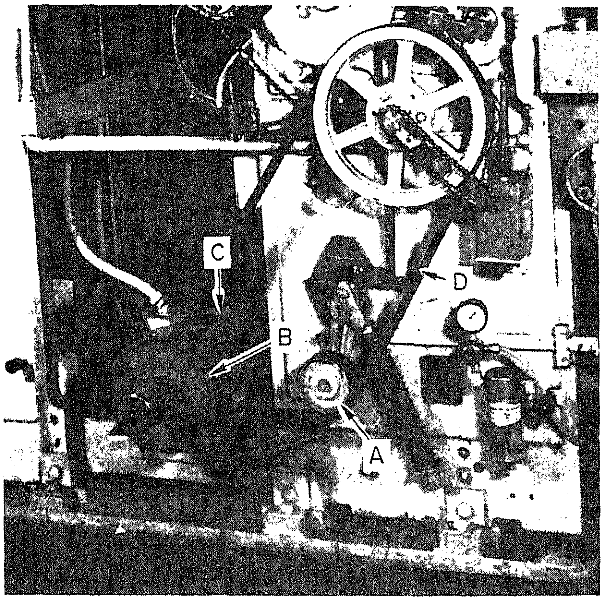
The variable speed control scale permits setting the press for any speed up to 7,500 impressions an hour. The speed can be preset with the handle and scale. When the press trips off impression or when it is stopped, it automatically goes into idling speed. However, a touch of the speed control pedal will return the press to the preset operating speed. When you increase the speed, the tension on the drive belt idler pulley shown in figure 14-7 is reduced. This allows the two halves of the spring-loaded drive pulley to move closer together. As they move together, the drive belt is forced to ride higher in the "V" position in the pulley; the higher it rides, the faster the press will operate.

On some presses, you can pull out on a speed control lever at the lower left side of the delivery unit to put the press on idling speed or to run it at operating speed during washup operations.

(NOTE: Never engage the feeder when the press is running at operating speed. The feeder should be engaged only at idling speed.)

TURNING THE PRESS BY HAND

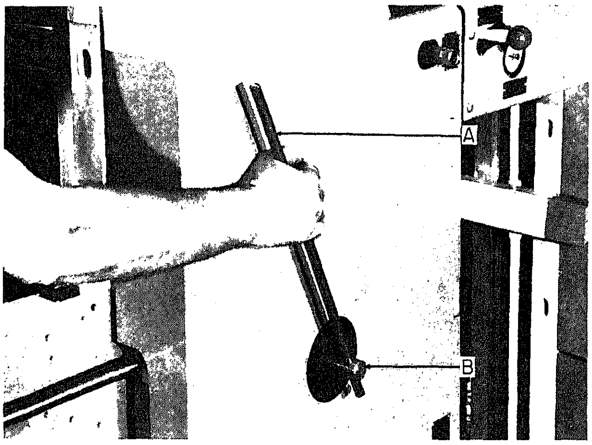
This press is not equipped with a handwheel for turning it manually. However, the drive shaft extends through an opening in the casement on the near side of the press. There you can insert a detachable handle through a hole in the drive shaft, as shown in figure 14-8, and turn it when it is desirable to rotate the press by hand.



A. Idler pulley.
B. Spring-loaded drive pulley.
C. Motor.
D. Drive belt.

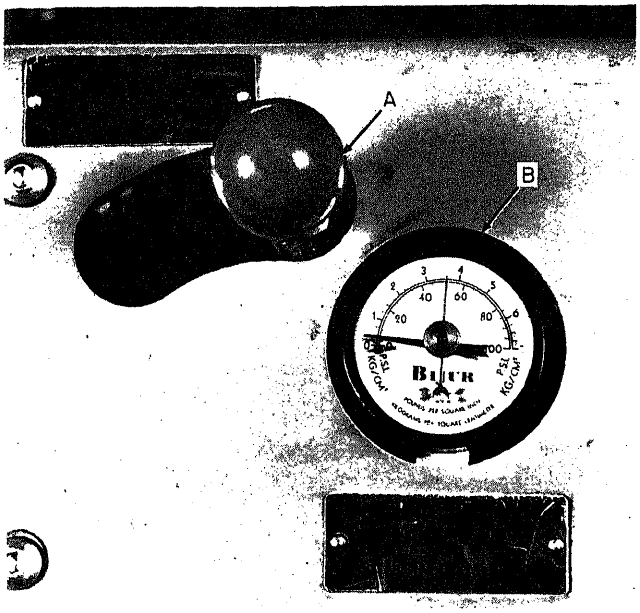
113.351

Figure 14-7.—Drive belt.



113.352X

Figure 14-8.—To turn the press manually, insert the detachable handle (A) through the hole in the end of the drive shaft (B) and turn.



A. **Feeder latch lever. Push to right to trip off impression. Push to left to the first notch to set feeder in motion; push to left to second notch to throw on impression.**
B. **Pressure gauge for oil pump.**

113.353
Figure 14-9.—The feeder latch lever.

FEEDER LATCH LEVER

The feeder latch lever shown in figure 14-9 has three operating positions and functions. One is to set the feeder in operation, one is to put the press on the impression, and the third is to trip off the feeder and the impression pressure and slow down the press to idling speed. This lever is located above and to the left of the pressure gauge for the oil pump on the near side of the press.

The lever is in the trip position when it is pushed toward the feeder end of the press. When it is pulled to the left to the first notch, the feed table starts to rise and the feeder and registering mechanisms are set in motion.

If the lever is pushed to the left (to the second notch), the impression pressure will go on, the ink rollers will drop, the ink ductor roller and sheet detector will become active, and the counter will start, provided it is turned on at the feeder end of the control panel.

Although the feeder is set in motion when the impression lever is moved to the first position, the sheets do not start traveling down the tape table until the air and vacuum are turned on.

Most press operators keep one hand on the feeder latch lever as they turn on the suction so that they can throw on the impression just as the lead edge of the first sheet reaches the side guide.

IMPRESSION TRIPS

The electrically controlled trip button is for tripping off the impression from the delivery end of the press. You should use it if the sheets stick to the blanket or wrinkle in the press. You can use the feeder latch lever (see fig. 14-9) to trip off the impression when you are on the near side of the press.

FEEDER UNIT

Although this press is stream fed, it is equipped with a conventional feeder table of the type with which you are already familiar. In stream feeding, the suckers start forwarding a second sheet before the first sheet has cleared the pile, and this causes the sheets to overlap one another as they travel down the tape table. This causes four or five sheets to be on the conveyor tapes of the tape table at the same time.

The feeder operates at full press speed, but the sheets on the conveyor tapes move at about one-fourth of the press speed. This slower speed provides better register because it keeps the sheets from bouncing or nicking when they reach the stop fingers at the end of the tape table.

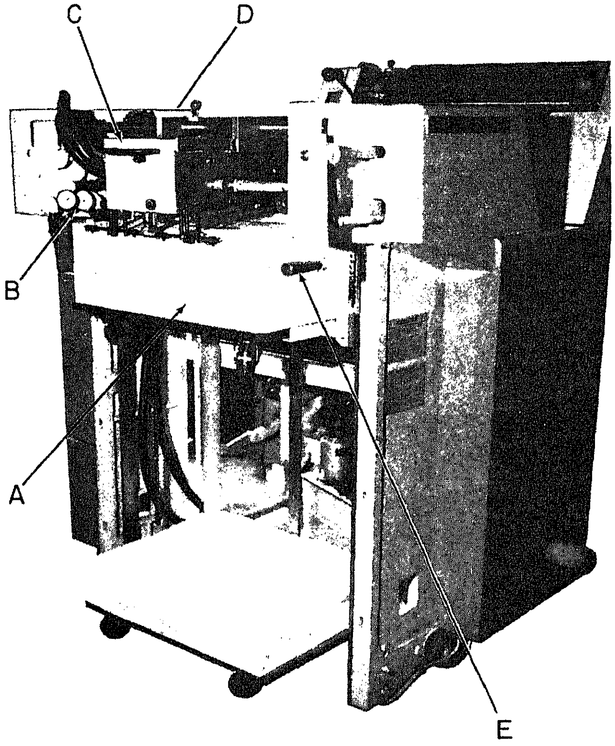
Raising and Lowering Controls

The feed table can be raised by using either of two methods. You can allow it to work up (raise) automatically until it is stopped by the pile height governor, or you can raise it manually.

To raise the table manually, you should push in on the crank handle, as shown in figure 14-10, and then turn it clockwise. To lower the table, you should push in and turn the handle counterclockwise. When the handle is pushed in, you interrupt the electric circuit and the pile-elevating solenoid becomes inoperative. You must be sure to pull the handle all the way out after you have used it to raise or lower the feed table manually. If you do not, it will prevent the feed table from raising automatically while the job is running.

Feed Table (Pile Board)

As you can see in figure 14-10, the feed table (pile board) is actually a detachable dolly. Presses are generally equipped with two or more of these dollies so that one can be loaded while the stock



A. Detachable dolly serves as feed table.
B. Gauges for blast and vacuum.
C. Separator unit.
D. Clamp for unlocking separator unit (hidden).
E. Crank for raising and lowering feed table by hand.

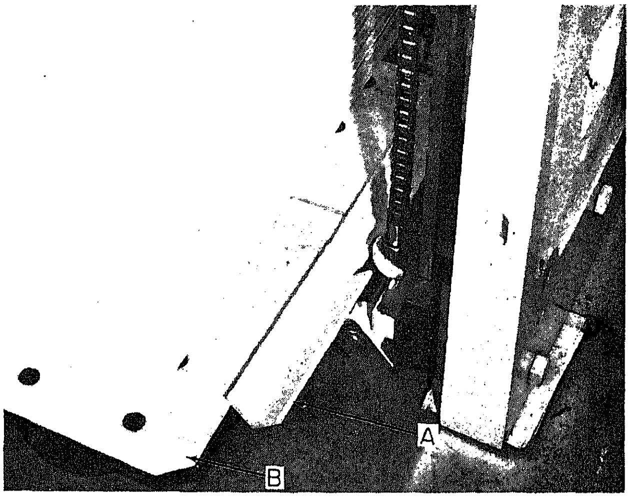
113.354X

Figure 14-10.—You can load paper on one dolly while the stock is being fed from another.

is being fed from the other. The press will take a dolly with a stack of paper 41 inches high.

When the pile on the first feed table dolly is about depleted, you can place another dolly in position below the first feed table, as shown in the illustration, and load it (or you can wheel in a new load of stock that has been loaded somewhere else). When all stock is depleted from the first feed table, you should remove the table and push in on the crank for raising and lowering the feed table by hand and turning it counterclockwise. This will lower the pile board supports shown in figure 14-11. The supports will tilt to pass below the edges of the second feed table, then they will engage the table as you raise the second pile into feeding position with the crank.

Always load the stock onto the dolly about 1/4-inch off-center toward the side guide to be used and flush with the front edge of the platform.

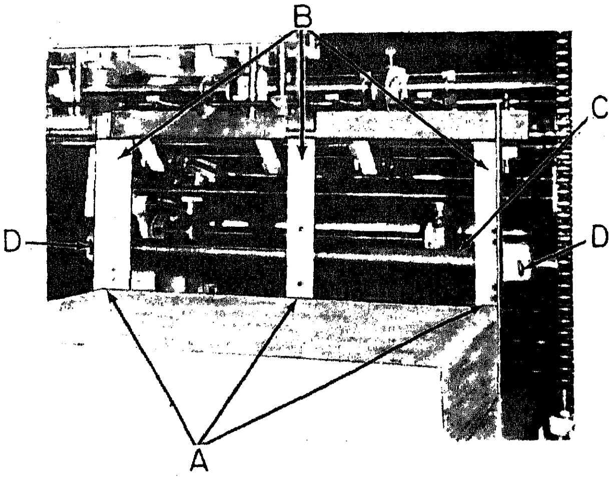


A. Pile board support.
B. Detachable dolly.

113.355X

Figure 14-11.—Pile board supports.

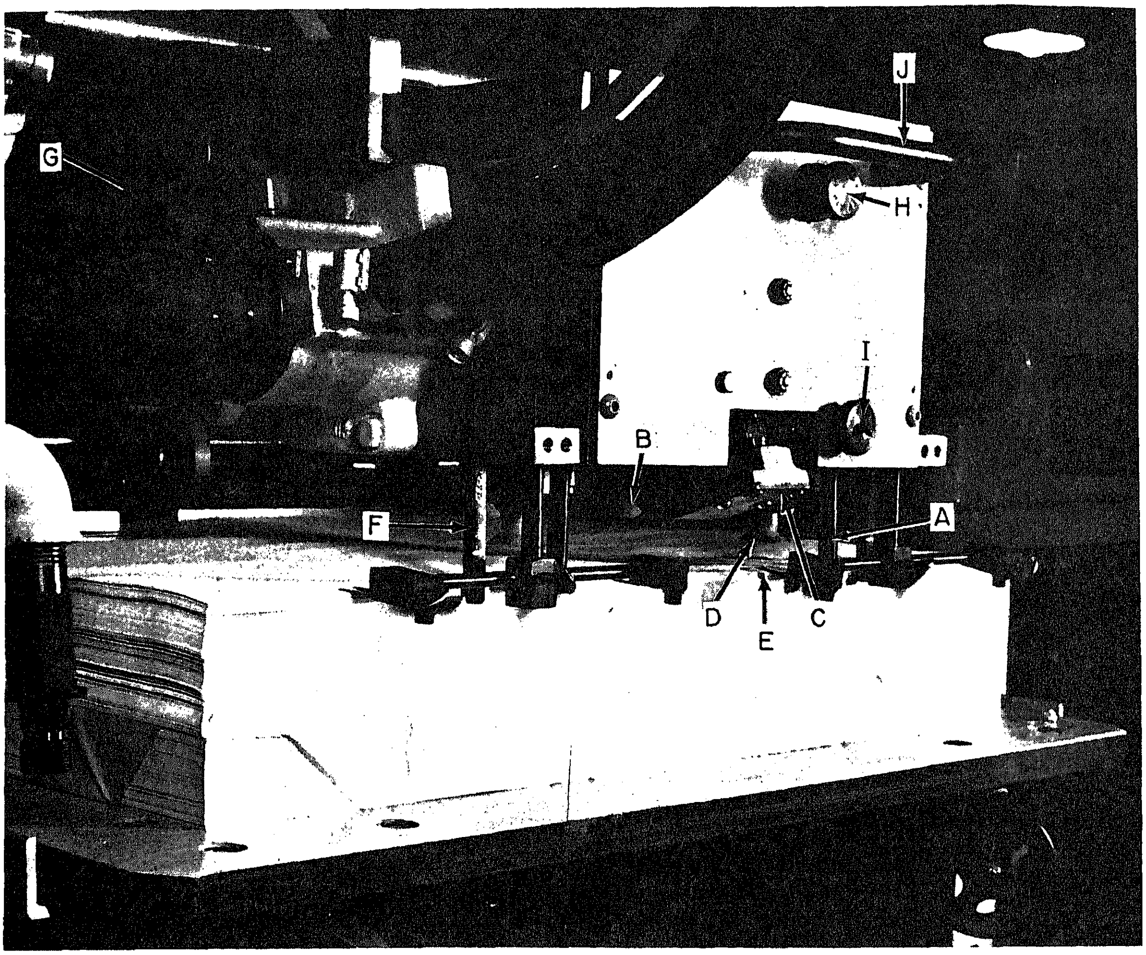
The press is equipped with front and corner piling bars to aid you in positioning the stock. These bars extend all the way to the floor, and you can use the graduated scale shown in figure 14-12 in positioning or setting these piling bars. You can



A. Front edge of sheet.
B. Piling bars.
C. Scale used in setting piling bars.
D. Thumbscrew. Loosen to move piling bar sidewise.

113.356

Figure 14-12.—Front and corner piling bars.



A.	Blast pipe.	F.	Pile backers. Keep sheets from bouncing back.
B.	Forwarding suckers.	G.	Clamp for locking separator unit in place (hidden).
C.	Hold-down foot.	H.	Air separation control knob.
D.	Pickup suckers.	I.	Pile height governor adjusting knob.
E.	Stripper fingers.	J.	Handle for moving separator unit forward or backward.

113.358

Figure 14-13.—Separator unit.

move the bars by loosening a thumbscrew and sliding them sidewise. Set the corner piling bar guides about one-fourth inch in toward the side guide being used so that the stock will feed slightly off-center of the tape table to allow for side guiding.

Pile Height Adjustment Knob

The pile height governor adjusting knob shown in figure 14-13 is located on the separating mechanism frame. Inside the separator unit frame is a cam-operated actuating rod which moves up and down against the stack as the press operates. This rod drops lower and lower as sheets are fed from the pile until one end of it finally contacts a microswitch located inside the separator. The microswitch then activates the pile-raising solenoid, which causes the pile to raise. This keeps the pile at the proper height to ensure continuous feeding.

The position at which the pile height adjusting knob is set determines the distance between the actuating rod and the microswitch, and this regulates the frequency with which the microswitch operates. As the actuating rod moves up and down, it alternately operates the microswitch, which raises and regulates the height of the pile.

When the microswitch signals the pile-raising solenoid to raise the feed table, it also signals a similar solenoid at the delivery end of the press, and this second solenoid acts to lower the delivery pile. There is also a switch located on the near side above the feed table. When the feed table contacts this switch, it causes elevation of the feed table to stop so that the feed table will not work up against the separator mechanism as the last sheets are fed into the press.

Turn the pile height governor adjusting knob shown in figure 14-13 counterclockwise to make the pile run higher and turn it in the other direction to cause the pile to run lower. The operating height of the pile is normally one-fourth inch below the top of the flaps on the flap shaft at the gripper (leading) edge of the sheet. The two pile backers shown in the illustration have a white horizontal line on them to indicate the proper pile height. You can use this line by raising the paper pile in the feeder until the line is level with the top sheet of the pile.

If the pile is too high, the press may feed double sheets; and if it is too low, the feeder may misfeed a sheet. A slight turn of the pile height governor adjusting knob changes the height of the pile considerably, so don't turn it too far at any one time in either direction.

SEPARATOR UNIT

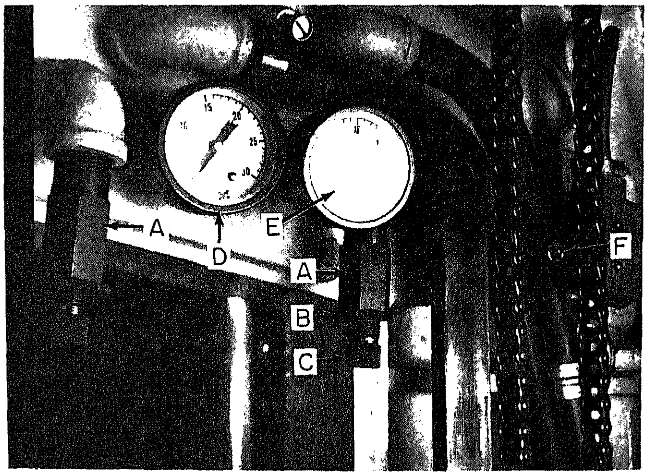
As you can see in figure 14-13, the sheet separator is a unit that is centered over the stack left to right. It consists essentially of two blast pipes (blow tubes), a hold-down foot, the pickup suckers, the stripper fingers, the pile backers, the pile height governor adjusting knob, and the air separation control knob.

When the press is in operation, air is emitted through holes in the blast pipes shown in figure 14-13 to create a slight separation of the top sheets in the pile. The hold-down foot raises to clear the top sheet which is then lifted by the pickup suckers. Next, the hold-down foot swings down against the second sheet to steady it as the top sheet is moved forward. The pickup suckers lift the top sheet until it contacts the forwarding suckers, and the sheet is held momentarily by both the pickup and the forwarding sets of suckers. The vacuum then shuts off in the pickup suckers, and the sheet is moved forward by the forwarding suckers. The blast pipes then release a blast of air that floats the top sheet and aids in moving it to the forwarding rollers. The suction in the forwarding suckers shuts off when the sheet is approximately one-fourth inch under the forwarding rollers, and the sheet is released to these rollers which force it onto the tape table. Metal tongues (strippers) ride the back edge of the paper stack to prevent more than one sheet from being picked up at a time. Also, two small metal fingers (called pile backers) are set against the back edge of the pile to keep the sheets from bouncing out of place. The pile backers have a white horizontal line to indicate the proper pile height, and you can use this as a guide when you are raising the feed table.

Since the separator unit is centered, it can handle any width of paper stock without sidewise movement. However, when it is necessary, you should loosen the lock clamp and move it forward or backward to accommodate the differing lengths of the paper sheet. You should set it so that the pile backers are against the back edge of the pile. Then lock it in position. You can use the handle, too, for moving it forward or backward.

Next, position the stripper fingers on each side of the hold-down foot, as shown in the illustration. The flat tip of the stripper fingers should extend slightly over the back edge of the top sheet in the pile, and the strippers should bend down slightly to exert a mild drag on the stock. The inner pair of strippers should be set with more pressure on the top sheet than the outer pair.

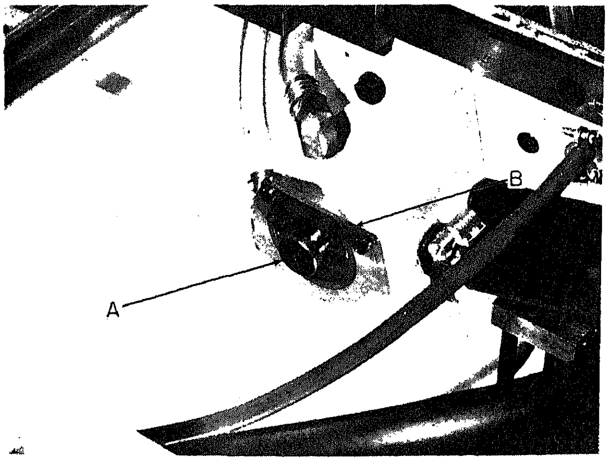
Turn the air separation control knob until the sheets in the top one-fourth inch of the pile are separated slightly by the air from the blast pipes. Adjust the ball check valves shown in figure 14-14



A. Separator unit ball check valves. Turn in to increase vacuum or blast.
B. Locking nuts for screws (C).
C. Adjusting screws for regulating vacuum and blast. To increase, loosen knurled nuts (B) and turn clockwise.
D. Blast gauge.
E. Vacuum gauge.
F. Switch that stops the rise of the feed table so that it will not work up too high as the last sheets are fed into the press.

113.359

Figure 14-14.—Separator unit ball check valves and gauges for vacuum and blast. Located on the near side inside the feeder frame.



A. Pretimed valve.
B. Latch.

113.360X

Figure 14-15.—The pretimed valve. Located on the near side of the separator unit.

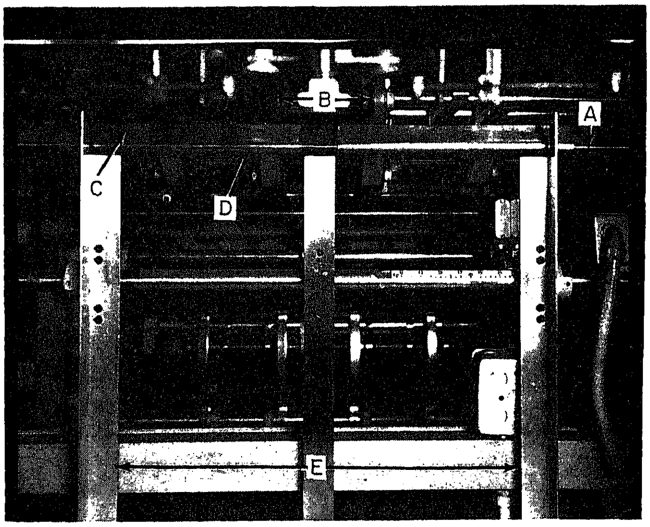
to control the supply of air and vacuum in the separating unit if necessary. The blast gauge indicates the air pressure in pounds per square inch (psi) and the vacuum in inches of mercury supplied. You will find that 8 to 10 inches of vacuum and 4 psi of blast are usually adequate. When more is necessary, loosen the locking nuts and turn the screws clockwise. To decrease, turn the screw counterclockwise. Then retighten the locking nuts.

The pretimed (rotary) air valve shown in figure 14-15 is located on the near side of the separator unit. This valve causes the suction and blast to go off and on at the proper time. It is factory set and normally needs no adjustment except in case it is accidently changed or is worn.

If it becomes necessary to remove the valve, you can lift the latch and slide the valve out. You should clean and oil it before putting it back into the press. The pretimed valve and bleeder holes of the separator unit should be kept clean. If the holes are filled with dirt, the forwarding suckers will not release the sheet at the correct time. This will cause the paper stock to feed crooked and may cause undue wear on the suckers.

FLAP SHAFT

The flap shaft shown in figure 14-16 is located at the front of the paper pile. It consists of two metal plates or flaps attached to a operated camshaft. When the press is in operation, the flaps move back and forth, tilting toward the tape table and serving as a ramp for the sheet as the suckers move it forward. Then the flaps swing back against the stack in a jogging action to help keep the front of the pile even.



A. Flap shaft.
B. Forwarding rollers.
C. Flaps.
D. Screws (hidden). Loosen to adjust flaps individually.
E. Piling bars.

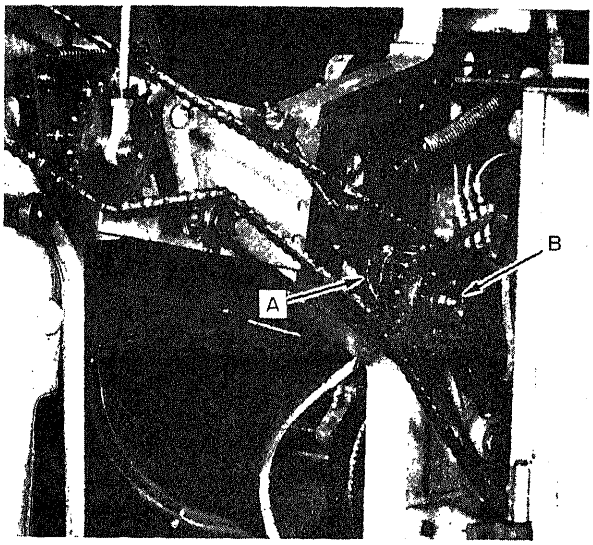
113.361

Figure 14-16.—The flap shaft shown with the feed table in lowered position.

The flap shaft cam shown in figure 14-17 should be adjusted so that the flaps will tilt toward the tape table just as the sheet starts to move forward. The flaps should move ahead of the forwarding suckers at a distance of one-eighth inch. You can loosen the screws shown in figure 14-16 to adjust the flaps individually, if necessary.

THE TAPE TABLE

The tape table is directly in front of the flap shaft and feeder unit. It consists of the forwarding rollers, sheet controls, conveyor tapes, sheet detector, caliper, front guides, sheet hold-downs, corrugating bar, and side guides. The functions of the tape table are to move the paper from the feeder unit to the printing unit. The tape table controls the sheets as they travel, and then it brings the sheets into register just before the impression cylinder grippers take the sheet through the printing unit.



A. Flap shaft cam.
B. Feeder elevator drive sprocket.

113.362

Figure 14-17.—Flap shaft cam.

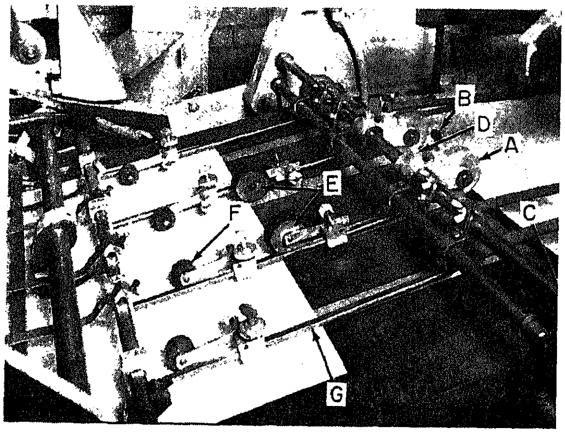
Forwarding Rollers

The forwarding rollers shown at the feeder end of the tape table in figure 14-18 are similar to the forwarding rollers found on most presses. They catch the sheet and force it onto the moving conveyor tapes of the tape table. These rollers should be positioned over the two inner conveyor tapes. You can move them sidewise, if necessary, by loosening the setscrews. You can regulate the tension on these rollers with the adjusting screws and you can raise them out of contact with the tape roller with their handle shown in figure 14-19. To keep the forwarding rollers from developing flats, you should raise them when the press is shut down for any length of time.

Sheet Controls

The sheet control hold-down and tail brushes serve to help control the sheet as it travels on the tape table. To set the rubber-tired wheels shown in figures 14-18 and 14-19, you should place a sheet of the stock to be run on the feed table, then position the wheels over the two inner conveyor tapes so that they will just clear the back edge of the sheet when it is against the front guides.

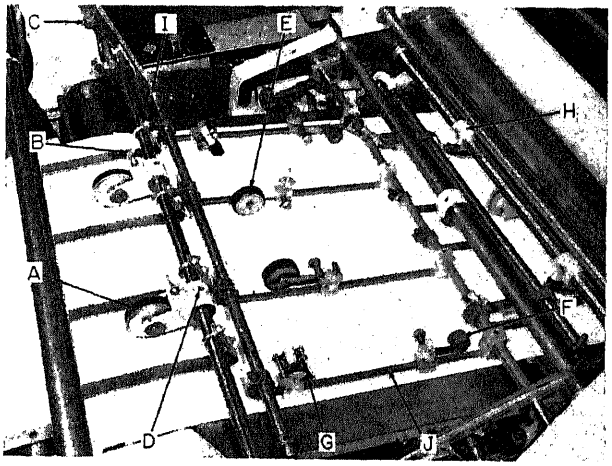
Place the wooden wheels close to the front guides so that they will rest on the sheet after it



A. Forwarding rollers.
B. Screws for adjusting tension on forwarding rollers.
C. Handle for raising and lowering forwarding rollers (hidden).
D. Setscrews. Loosen to move forwarding rollers sidewise.
E. Hold-down wheels.
F. Hold-down wheels.
G. Metal sheet guides.

113.363

Figure 14-18.—Tape table controls.



A. Forwarding rollers.
B. Screws for adjusting tension on forwarding rollers.
C. Handle for raising and lowering forwarding rollers.
D. Setscrew. Loosen to move forwarding rollers sidewise.
E. Hold-down wheels.
F. Hold-down wheels.
G. Brushes.
H. Front guides.
I. Trim rack positioning setscrew.
J. Metal sheet guides. Lift crossbar at feeder end to raise guides as a unit.

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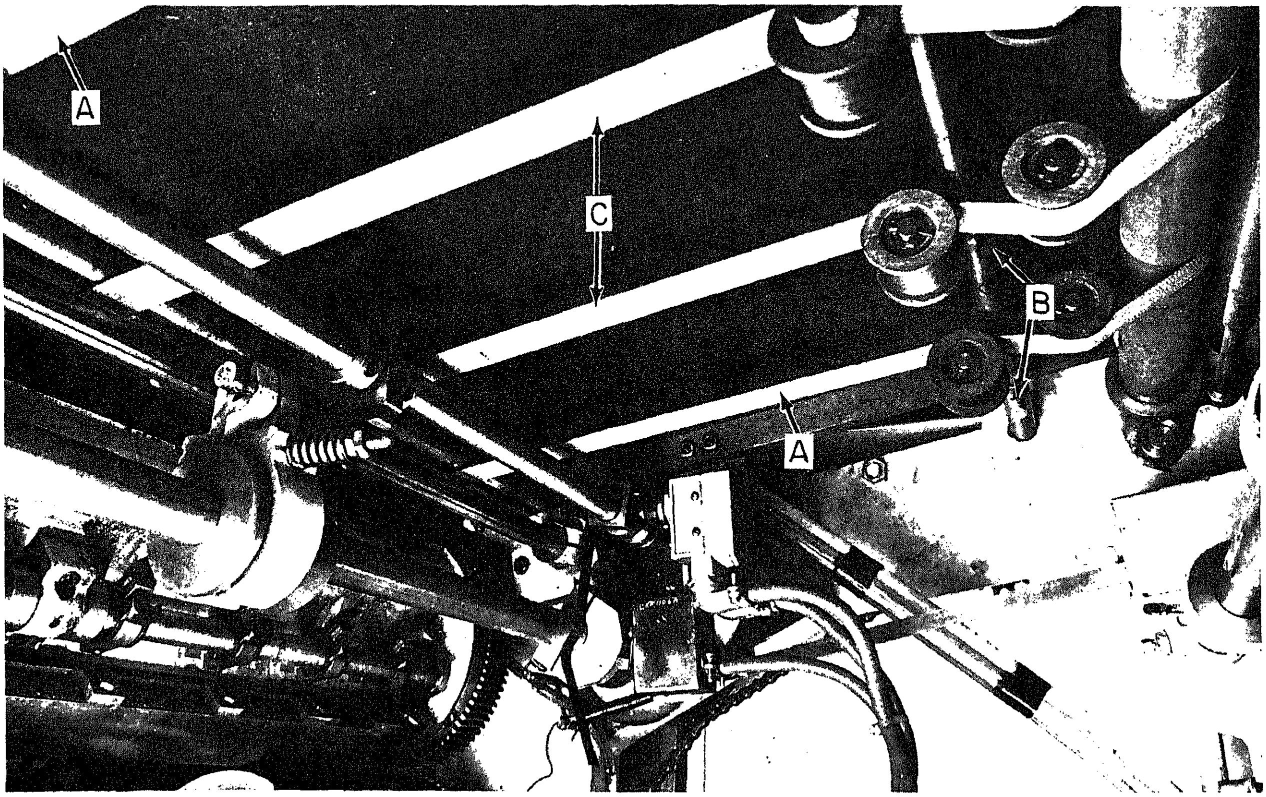
Figure 14-19.—Tape table controls.



A. Outer tapes.
B. Screws. Loosen to slide the tape tension brackets sidewise.
C. Inner tapes.

113.365

Figure 14-20.—Conveyor tapes as seen from below the tape table.

reaches the guides. If the sheet is small, you should use an additional pair of wooden wheels so that the sheet will be under control during its entire journey down the tape table.

The tail brushes shown in figure 14-19 should ride the tail (back) edge of the sheet to prevent the paper from bouncing when it reaches the front guides of the tape table.

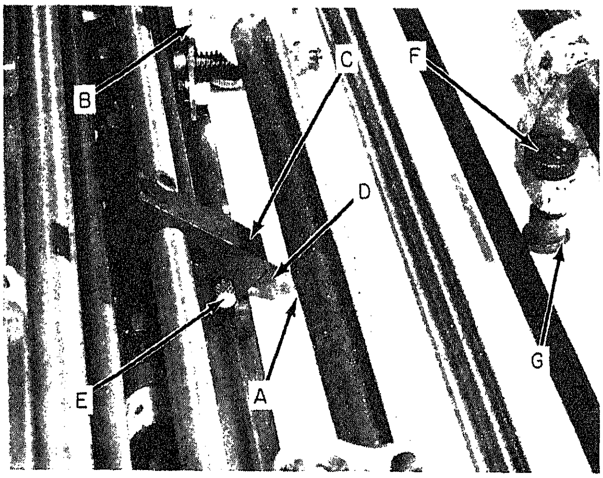
Conveyor Tapes

The press has four conveyor tapes. You can move the two outer tapes sidewise as necessary to accommodate sheets of different widths by loosening the screws shown in figure 14-20 and sliding the tape tension wheel brackets. Normally, you should set the outer tapes 1 inch in from the outer edges of the sheet. Then set the other two tapes at equal distances between the outer tapes and retighten the screws.

Sheet Detector

If a sheet fails to feed through properly, the sheet detector shown in figure 14-21 will contact the undertongue below it and complete an electric circuit to the solenoid which will stop the feeder, take the press off of impression, raise the ink rollers, stop the lowering of the delivery pile, and put the press on idling speed. When you engage the feeder latch lever and put the press on impression again, all adjustments return to their operating settings (except the press speed).

The sheet detector is factory set and requires no adjusting unless the contactor becomes bent or damaged. It is centered on the tape table and cannot be moved sidewise. If the contactor does not make good contact with the undertongue, it may be necessary to adjust the spring contactor slightly. A dirty undertongue may also prevent



A. **Sheet detector.**
B. **Front guides.**
C. **Setscrew. Loosen to slide detector tube in and out of holder to position it on sheet.**
D. **Detector tube.**
E. **Knurled screw. Turn to withdraw tube from base.**
F. **Knurled knob used in setting the caliper for thickness of stock.**
G. **Caliper.**

113.366X

Figure 14-21.—The sheet detector and the caliper.

Front Guides

This press has two front guides and four undertongues. The front guides should be set over the two inner tongues when you are running wide stock and over the two inner undertongues when you are running narrow sheets. To move the front guides sidewise, as shown in figure 14-22, you should rotate the press until the guides rise. Then loosen the setscrews and slide the guides along the shaft until they are centered over the new set of undertongues.

You can use the screws on the guide for adjusting the gripper margin (bite) and for ensuring that the stock is fed into the grippers parallel to and even with the front edge of the gripper contact blocks. A clockwise turn will give you less margin at the top or gripper edge of the sheet and a counterclockwise turn will give you more. If you change the guides setting for a particular job, always return them to their original setting when you finish the job. As you turn the screw to adjust the gripper margin, each click of the screw represents a movement of 0.001 inch.

The flat spring guide underneath the front guides holds down the front edge of the sheet and proper contact so you should keep the undertongue clean.

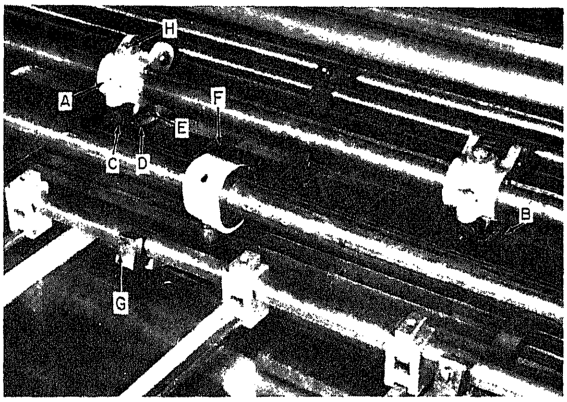
(NOTE: Some of these presses come equipped with a mechanical rather than an electrical trip.)

Caliper

The caliper is positioned at the end of the tape table near the front guides. (See fig. 14-21.) Double sheets are stopped by the caliper causing the sheet detector to trip the press out of impression. This tripping action is progressive. When you resume printing, all press operation settings, except speed, return to their former settings.

To set the caliper for the thickness of the stock being run, you should rotate the press until the caliper is in its down position. Then adjust with the knurled screw until one sheet will pass freely, but two sheets will bind.

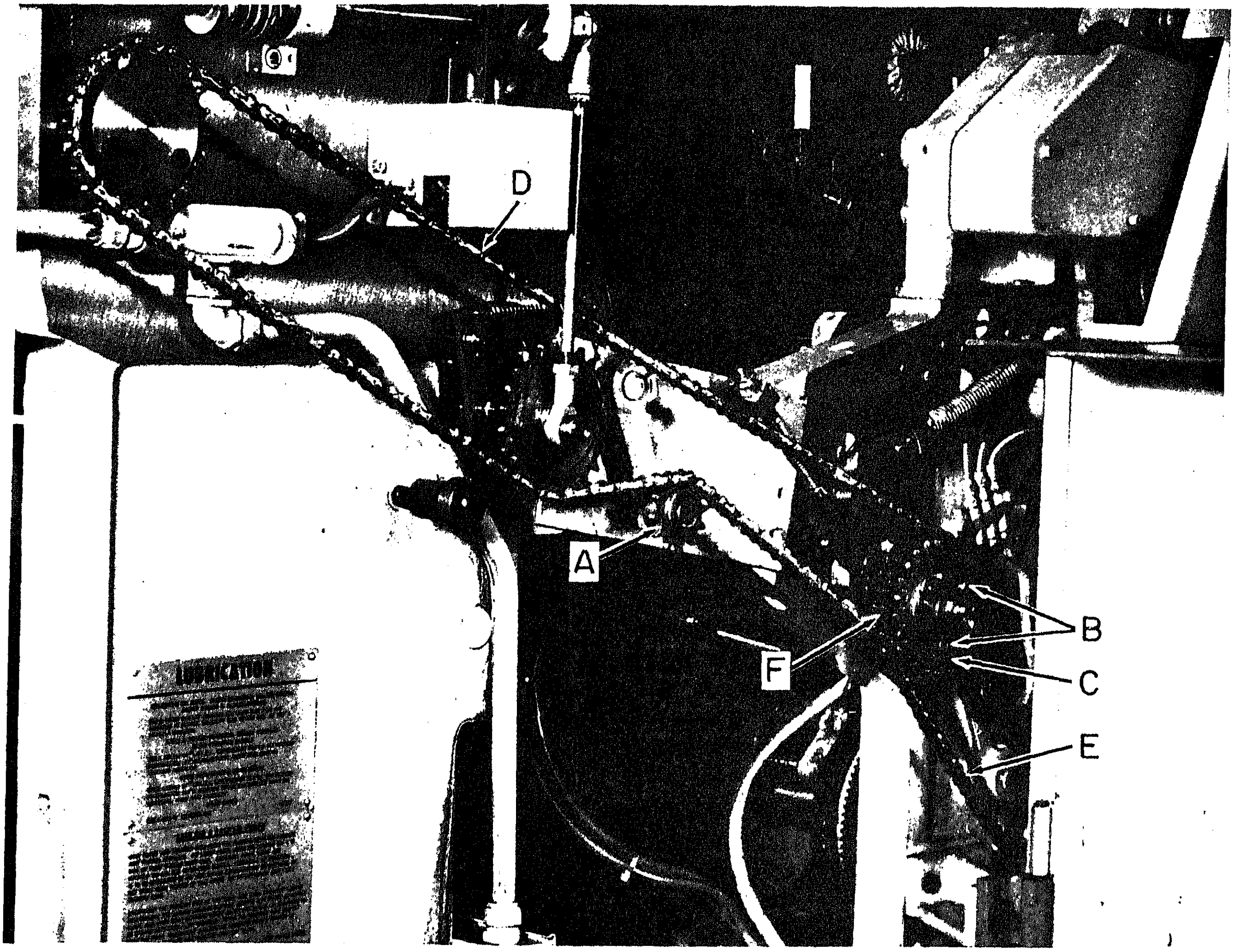
When sheets wrinkle or are caught by the caliper on the tape table, you must lift the crossbar (at the feed table end) and raise the metal sheet guides which rest on the sheet as a unit to remove the paper from the tape table.



A. **Front guides.**
B. **Outer undertongue. Position guide over this undertongue when you are running wide sheets.**
C. **Screw for adjusting gripper margin.**
D. **Flat spring guide directs sheet into front guide pin.**
E. **Adjusting nut for adjusting clearance between sheet and guide (D).**
F. **Sheet hold-downs.**
G. **Adjusting screw for hold-downs (F).**
H. **Setscrew. Loosen to move front guide sidewise.**

113.367

Figure 14-22.—Front guides.



A. Drive chain idler sprocket.
B. Cap screws.
C. Feeder drive sprocket.
D. Drive chain.
E. Camshaft drive chain.
F. Camshaft.

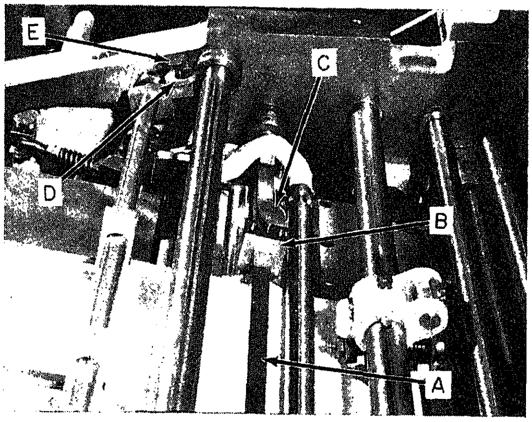
113.368

Figure 14-23.—Adjustments for timing sheet to front guides.

directs it into the guide pins. You can regulate the clearance between the sheet and the sheet guide with the knurled adjusting nut. The sheet should move freely, but should not buckle as it reaches the guides.

The front guides are timed to drop when the front or gripper edge of the sheet is one-fourth inch away from them. However, the weight or finish of a particular stock may cause it to arrive at the guides too late or too soon. You can check the timing by moving (jogging) a sheet down the examine the position of the sheets in relation to the guides.

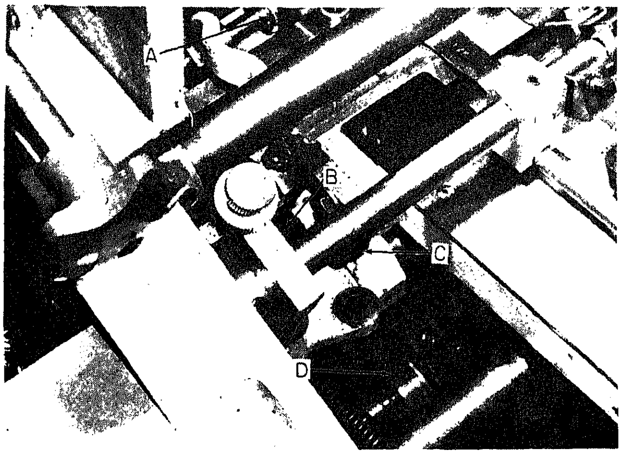
If the timing is slightly off, loosen the tension on the drive chain idler sprocket shown in figure 14-23. Then loosen the cap screws and move the feeder drive sprocket in the elongated slot. If the sheet is too far out of time, it may be necessary for you to loosen the drive chain idler sprocket and move the drive chain forward or backward in relation to the feeder drive sprocket. To check the timing, you should reset the drive chain idler sprocket and rotate the press, jogging several



A. Overhead side guide bar.
B. Side guide.
C. Thumbscrew. Loosen to move guide sidewise.
D. Locknut for adjusting screw (E).
E. Adjusting screw for adjusting all the hold-downs (F) shown in figure 14-22 simultaneously.

113.369X

Figure 14-24.—Side guide.



A. Corrugating bar.
B. Lock screw.
C. Adjusting screw for adjusting height of corrugating bar.
D. Corrugating bar cam.

113.370X

Figure 14-25.—Corrugating bar.

Sheet Hold-downs

The sheet hold-downs steady and stiffen the sheet while it is in contact with the front guides. You can adjust these hold-downs individually or as a unit to accommodate different thicknesses of stock. If they are set too low or if they are nicked or dirty, they will exert a slight drag on the stock and interfere with the sheets movement. If they are set too high, the stock may curl or buckle. To adjust the hold-downs individually, loosen the locknut for the adjusting screw and place three sheets of the stock to be run under each hold-down. Lower the hold-downs against the stock and set the adjusting screws, then tighten the locknut. If the adjustment is correct, three sheets will be held with a slight tension, but two sheets will be free. (Use a sheet of the stock to be run and a sheet of paper 0.005 inch thick when you are adjusting the hold-downs for heavy stocks, such as cardboards.)

You can adjust the hold-downs as a unit by loosening the locknut shown in figure 14-24 and turning the adjusting screw.

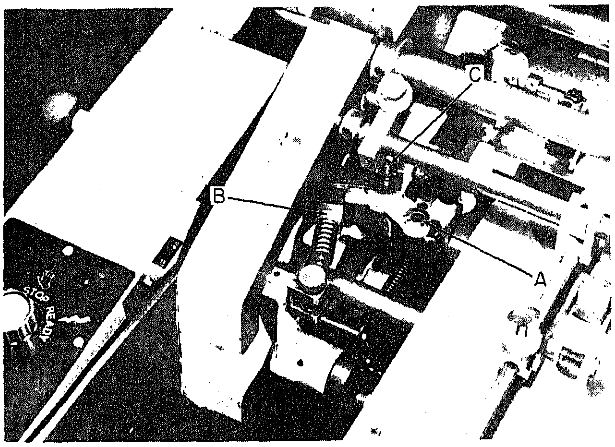
Corrugating Bar

A sheet flattening bar (called a corrugating bar) drops lightly against the sheet as soon as it reaches the front guides. The bar steadies the sheet while it is moved into register by the side guide. (See fig. 14-25.) It is important that this bar contacts the sheet with the proper pressure. If there is too much pressure, the sheet may be pulled back from the front guides causing the press to trip off of impression and misregister, or the side guide may not be able to shove the sheet to the proper position sidewise. On the other hand, if there is too little pressure, the sheet may float away from the front guide when it is side guided. It may also be necessary to lower the bar slightly to exert more pressure for lightweight paper stocks. To adjust the height of the bar, loosen the lock screw and turn the adjusting screw to adjust the height of the corrugating bar.

Side Guides

This press is equipped with two push-type side guides, but only one is used at a time. You should move the unused side guide to the extreme edge of the tape table so that it will be out of the way when it is not needed.

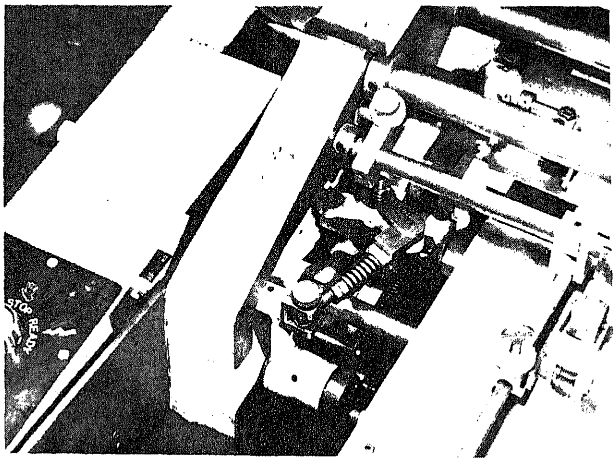
The side guides are attached to a cam-operated bar which moves back and forth when the press is in operation. To set the side guide, you should inch the press to jog a sheet down the tape table to the front guides. When the cam-operated bar has reached the end of its inward thrust, stop the press and move the sheet approximately one-fourth inch sidewise toward the center of the



A. Hole. Switch rod (B) to this hole when changing to far side guide.
B. Connecting rod.
C. Spring clip.

113.371X

Figure 14-26.—Side guide changeover mechanism. Use this setup when using side guide on near side of press. Switch to setup shown in figure 14-27 when using side guide on far side of press.



113.372X

Figure 14-27.—Side guide changeover mechanism. Use this setup when side guiding from far side of press.

feedboard. Then set the side guide against the edge of the sheet and lock it in place with the thumbscrew. You can make minor adjustments while the press is running with the knob on the side guide itself. Each click of the knob moves the side guide 0.002 inch.

It is necessary to reverse the direction of the movement of the side guide bar when you switch from one side guide to the other. To do this, you must change the position of the connecting rod shown in figure 14-26. You should position the lever as shown in the illustration when the near side guide is in use. To change to the far side guide, you must lift the spring clip and shift the connecting rod to the hole in the opposite end of the rod, as shown in figure 14-27.

THE PRINTING UNIT

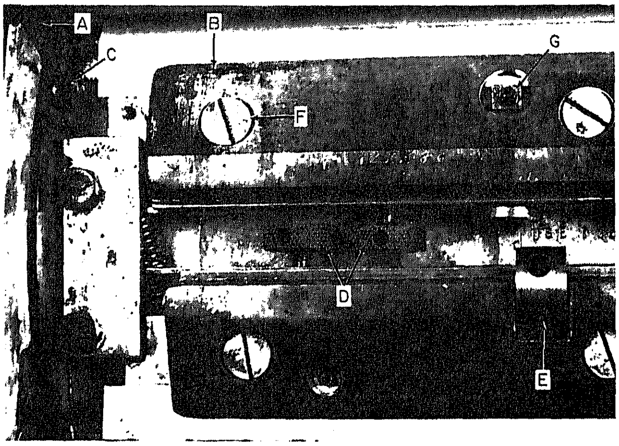
The printing unit consists of the plate cylinder, blanket cylinder, and impression cylinder and the inking and dampening units.

Cylinder Undercut

The body of the plate cylinder is undercut 0.015 inch below the bearer height, and the blanket cylinder is undercut 0.075 inch. The bearers of the impression cylinder are undercut 0.015 inch below the body of the cylinder to allow the proper squeeze between the blanket and impression cylinders. It is possible to change the length of the printing image by shifting packing from the plate to blanket cylinder or vice versa.

Mounting the Plate

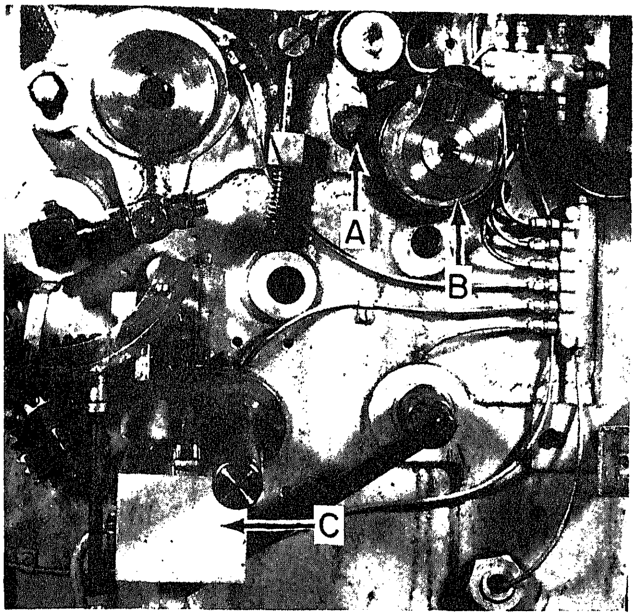
To mount the plate on the plate cylinder, you should loosen the plate-tightening screws shown in figure 14-28 and the clamp eccentrics. Turn the



A. Bearer.
B. Gripper edge plate clamp.
C. Side adjusting screws for centering plate or moving it sidewise.
D. Plate-tightening screws.
E. Clamp eccentrics.
F. Pivot screws for setting clamps to the thickness of the plate. Adjust these screws if you change to a plate of a different thickness.
G. Plate stop.

113.373

Figure 14-28.—Plate-mounting screws.



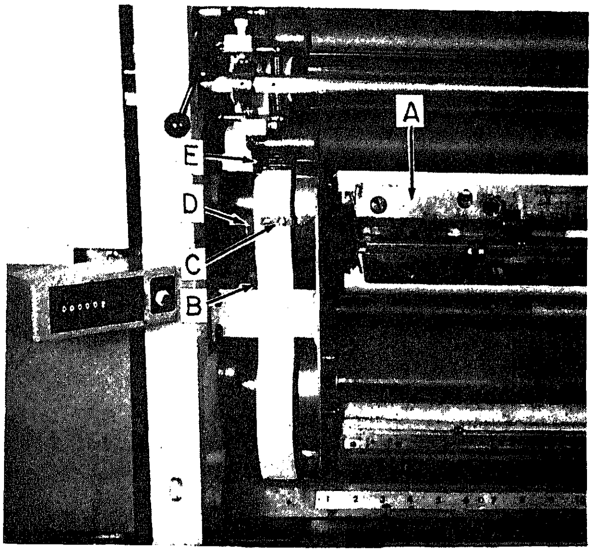
A. Cam roller.
B. Pressure throw-off cam.
C. Solenoid which causes delivery table to lower.

113.374
Figure 14-29.—Pressure throw-off cam.

plate-tightening screws to move the edge of the plate clamps up even with the edge of the cylinder. Insert the gripper edge of the plate in the upper set of clamps. Close and lock the clamps by inserting a pin wrench in the hole in the clamp eccentric and pulling up.

You should then place the trimmed packing behind the plate, allowing the packing to overlap the edge of the cylinder. This will prevent the packing from slipping. Most press operators pack the plate to bearer height on this press. If the plate is 0.008 inch in thickness, this means that you must use 0.007 inch of packing to bring it up to the height of the bearer.

Rotate the press forward by hand until the cam roller shown in figure 14-29 starts into the high dwell of the pressure throw-off cam. Then you can pull out on the ink throw-off handle and turn it so the form rollers will not drop when you put the press on the impression. Push the feeder latch lever to the second notch to put the press on impression and then rotate the press forward wrapping the plate and packing around the cylinder. When the cylinder gap comes into view again, you should insert the tail edge of the plate into the tail clamps shown in figure 14-28. Tighten the tail close and lock the tail clamps with the pin wrench. Then turn the plate-tightening screws to draw the plate taut. Trip the impression off and jog it around until the impression goes off; then tighten the plate-tightening screws again.



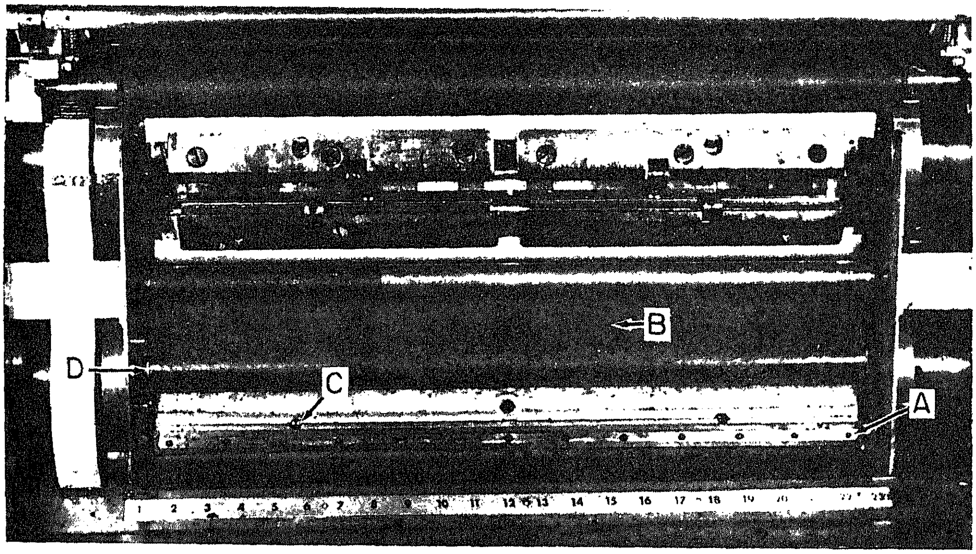
A. Plate cylinder.
B. Cap screws. Loosen to move undercut section of cylinder.
C. Pointer. Can be used as reference to show how far cylinder is moved.
D. Lock screws for backlash gear.
E. Backlash gear.

113.375
Figure 14-30.—Adjustment for raising or lowering the image on the paper.

It is necessary to adjust the pivot screws shown in figure 14-28 for the new thickness if you change to a plate of a different thickness so that the cam will produce the correct grip on the plate. Turning the screws in a clockwise direction will increase the tension and vice versa.

There are side adjusting screws for centering the gripper plate clamps (see fig. 14-28). They will also move the clamps sideways which moves the image on the press sheets.

You can raise or lower the image, if necessary, by loosening the cap screws shown in figure 14-30. Once these screws are loose, insert a pin wrench in the threaded hole in the gap of the plate cylinder and push up or down to move the cylinder. The cylinder can be moved a total of 4 inches. Of course, any of these movements move the plate in relationship to the stationary blanket so the image on the press sheet moves.



A. **Blanket bar.**
B. **Blanket.**
C. **Screws used to fasten blanket bar to cylinder.**
D. **Reel rod.**

113.376

Figure 14-31.—Mounting the blanket.

Mounting the Blanket

The blanket cylinder is undercut by 0.075 inch. Blankets are generally 0.065 inch in thickness; however, their thickness may change when they are stretched taut around the cylinder. Therefore, you will need to add packing under the blanket on a gradual basis to maintain the blanket at 0.003 inch above the bearer height. Without this required blanket height, the image on the plate will not transfer properly to the press sheets.

You must attach the blanket bars to the blanket with screws before mounting the blanket on the blanket cylinder. Once the bars are attached to the leading and trailing edge of the blanket, rotate the press until the blanket cylinder gap is facing you. Then slip the lead edge blanket bar into the slot provided in the cylinder's gripper or leading end. Tighten the two screws shown in figure 14-31 to lock the blanket bar in place. Next, insert the packing behind the blanket. To keep the packing from slipping, you should allow it to overlap the edge of the cylinder slightly. Rotate the press to wrap the blanket and packing around the cylinder. When you reach the cylinder gap again, attach the blanket bar to the reel rod and secure it with the two screws. Turn the reel rod with a wrench until the blanket is drawn taut. Lock the reel by slipping the pawl into the ratchet on the far side of the press.

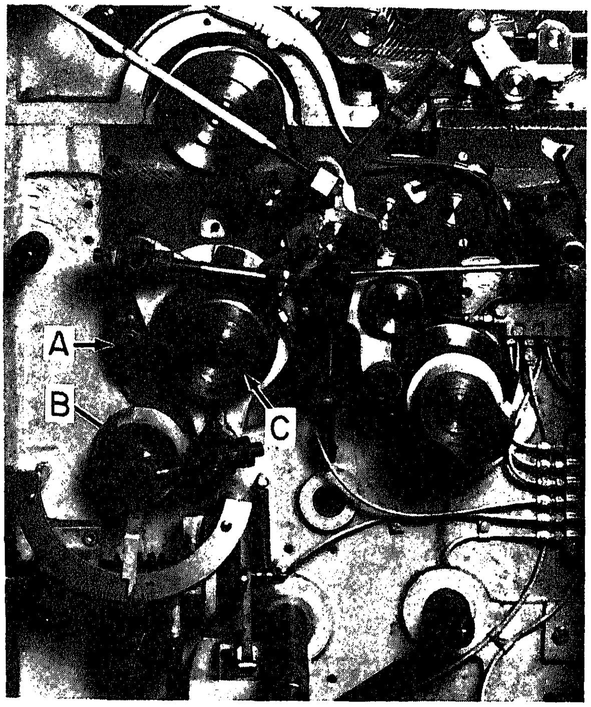
If the first printed image on the blanket is light, add 0.001 inch to 0.002 inch more packing, and check the quality of the image again. Continue to add packing until you have a satisfactory image.

After running a few hundred impressions, you should check the blanket; if necessary, tighten it again by turning the reel rod.

Most press operators loosen the blanket and allow it to rest when the press is secured for a length of time. It is also a good idea to rotate blankets, giving each blanket a resting period before it is used again. Many press operators keep a spare blanket with blanket bars attached ready to mount on the press whenever they might be needed.

Impression Cylinder

The bearers on the impression cylinder are undercut 0.015 inch to allow the necessary clearance when the plate or blanket packing is shifted to change the length of the image in close-register work. Of course, if you change the blanket packing, you must also change the impression cylinder pressure. The blanket must also be adjusted to the impression cylinder for the



A. **Cap screw.**
B. **Pressure capstan.**
C. **Blanket cylinder eccentric.**

113.377

Figure 14-32.—Stock thickness adjustment.

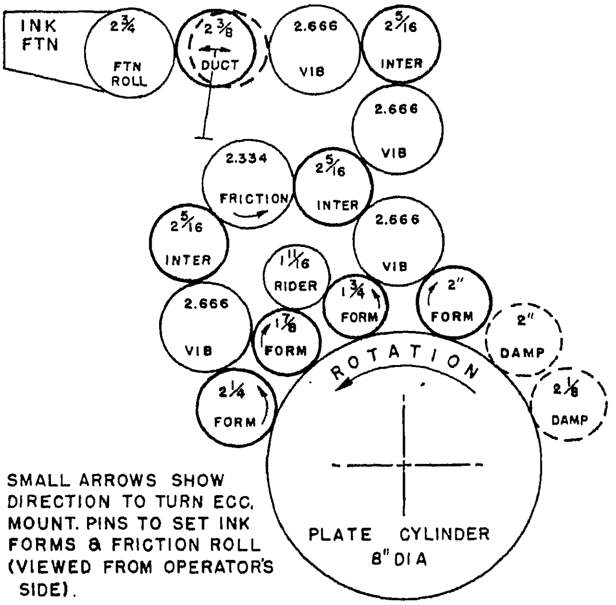
thickness of the stock being run. A 0.002-inch to 0.004-inch squeeze is generally required to provide the proper printing pressure.

To set the pressure, you should loosen the cap screw shown in figure 14-32 and insert the detachable handle into the pressure capstan. Move the blanket cylinder away from the impression cylinder until the print is light or broken. Then move it back until the image is printing properly and snug the cap screw. (The cap screw should not be too tight.)

The impression cylinder grippers are held closed by spring tension which permits them to adjust to different thicknesses of stock without resetting.

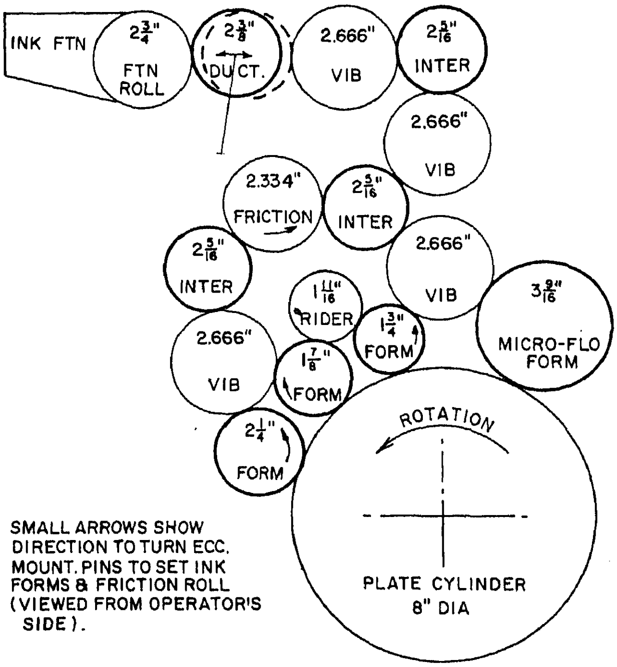
INKING SYSTEMS

There are two types of inking systems that are available for this press. The type you have depends on which dampening system is found on your press. Figures 14-33 and 14-34 show illustrations of the two roller arrangements for both the conventional and the micro-flo systems.



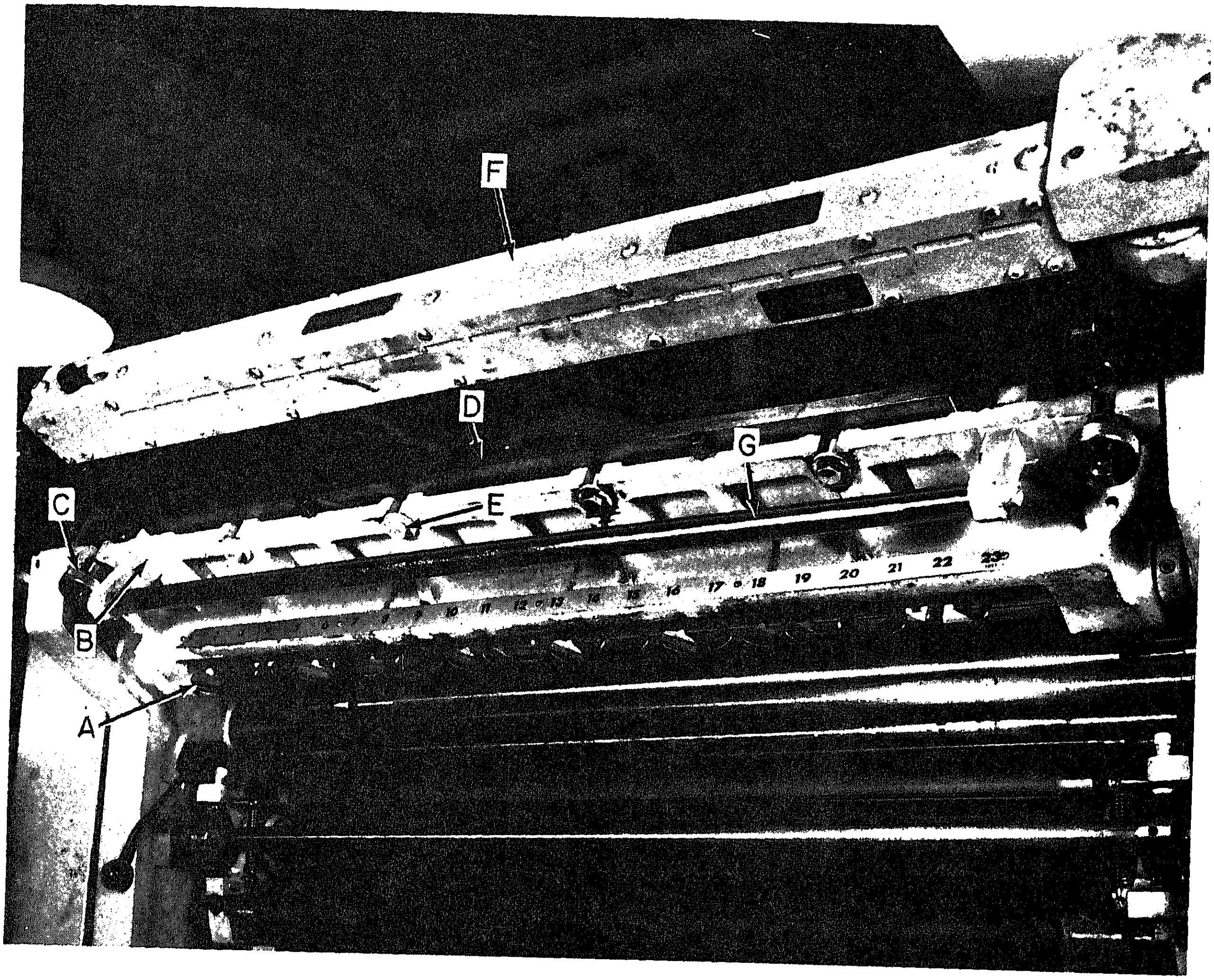
113.431

Figure 14-33.—Roller arrangement on the 19- by 25-inch Harris offset press having a conventional water fountain.



113.431

Figure 14-34.—Inking roller arrangement on the 19- by 25-inch Harris offset press equipped with a micro-flo dampening system.



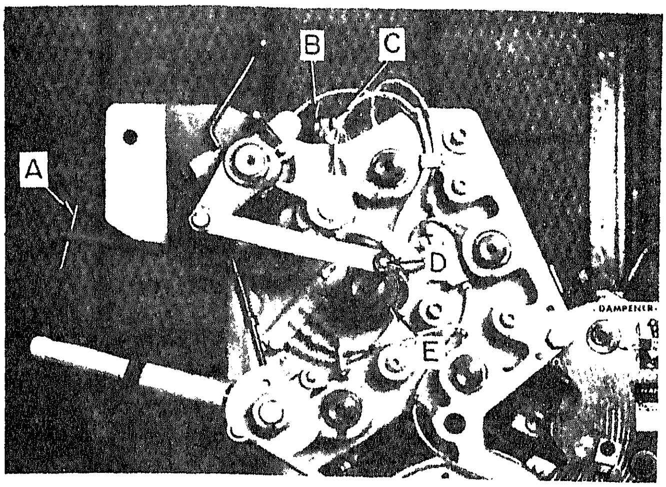
A. Fountain keys.
B. Fountain.
C. Knurled nuts. Loosen to move blade away from fountain roller.
D. Blade.
E. Screws. Loosen to remove blade from fountain.
F. Baldwin ink fountain agitator.
G. Bar.

113.383

Figure 14-35.—Ink fountain adjustments.

The ink form rollers are normally lowered to the plate automatically when the impression pressure is applied and are raised automatically when the impression pressure is released. This action is automatic when the throw-off handle is in the up position and the pin is engaged in the slot. When the handle is pulled to the out position and turned to hold the pin out of the slot, the rollers will not raise and lower automatically. To lower them by hand when the handle is in the out position, you simply pull the handle down. Push it back up without returning the pin to the slot to raise the rollers manually.

The ink fountain is similar to that found on other offset presses (see fig. 14-35). The feeding of ink feed is regulated by the fountain keys (thumbscrews) which control the thickness of the ink on the fountain roller. To aid you in setting the fountain keys, there is a scale with a numbering code for each fountain key directly below the ink fountain. There is a similar numbered scale above the delivery table. If the ink is running light in a certain area, you simply read the numbers from the scale over the delivery table and adjust the fountain keys having the



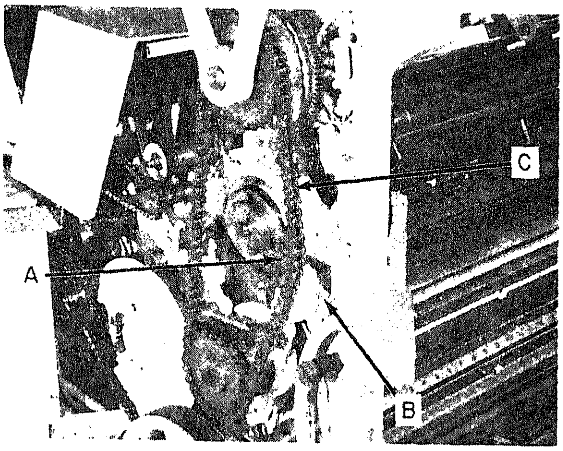
A. T-handle used to control motion of ductor roller. (A star wheel is used instead of the T-handle on some presses.)
B. Setscrew. Loosen to install ductor roller in bearing holder (C).
C. Feed side bearing holder.
D. Cam roller.
E. Ductor roller cam.

113.381
Figure 14-36.—Ductor roller controls.

to rotate the fountain roller manually when you are setting the fountain keys or when it is desirable to increase the supply of ink overall momentarily.

The ink supply is further regulated by the ink feed control lever which regulates the rate of turn of the fountain roller. You should set this lever in the second notch for most work, but if more ink is required, you should move it towards the feeder end of the press. Moving it all the way toward the delivery end cuts off the ink supply completely.

You can also shut off the ink supply by stopping the movement of the ductor roller with the T-handle or star wheel shown in figure 14-36. This T-handle has three operating positions. You can set the ductor roller to operate automatically when the press is running by turning the T-handle counterclockwise and allowing it to remain free in its neutral or center position. You can stop the movement of the ductor entirely by turning the star wheel counterclockwise and then lifting up on the handle and turning it clockwise. This action cuts off the ink feed to the rollers because the ductor is no longer moving ink from the fountain roller.



A. Idler.
B. Adjusting screws.
C. Chain.

113.382X
Figure 14-37.—Drive chain for ink rollers.

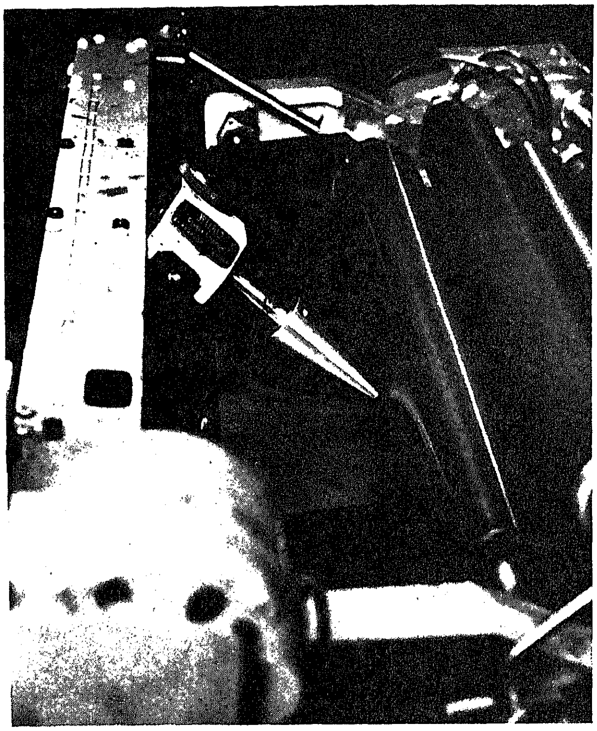
You can make the ductor roller operate continuously regardless of whether the impression pressure is off or on by turning the T-handle counterclockwise and then moving the handle down and turning it clockwise.

You can lower the ink fountain until it is out of contact with the ink fountain roller during cleanup operations by loosening the knurled nuts shown in figure 14-35. Then swing the knobs of the knurled nuts up and pull down on the bar. To remove the fountain blade, loosen the four screws shown in the illustration.

The ink rollers are power driven by a chain operating from a sprocket outside the gear at the far end of the blanket cylinder. It is possible to adjust the idler shown in figure 14-37 to regulate the tension on this chain. However, once the tension idler is set, you should not change it except when necessary. Never attempt to adjust the tension when the impression pressure is off because the blanket cylinder eccentrics move when the impression is turned on, and this may cause the chain to become too tight.

Ink Fountain Agitator

These Harris presses can be equipped with an Ink Fountain Agitator, as shown in figure



113.384
Figure 14-38.—Baldwin ink fountain agitator.

14-38. This device consists of a rotating cone which moves from side to side in the fountain, stirring the ink and forcing it against the fountain roller. It is operated by a separate motor and can therefore run even when the press is not operating.

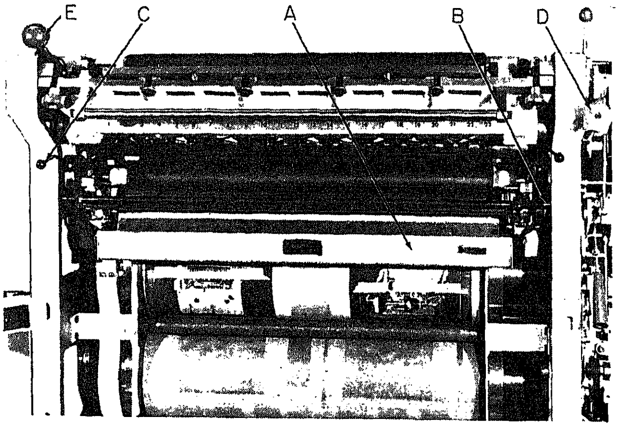
Washup Attachment

To clean the ink rollers, you can use a washup attachment like the one shown in figure 14-39. The two support pins are for attaching it to the machine. After you attach the washup attachment with the support pins, lift the two levers to bring the washup blade into contact with the vibrator roller.

DAMPENING SYSTEM

To transfer the correct amount of fountain solution to the offset plate during any lithographic job is, of course, a very important procedure.

The two dampening systems perform this function in different ways, and they both will be discussed in the following section.



A. **Washup attachment.**
B. **Support pins.**
C. **Levers. Lift to bring the washup blade into contact with the vibrator roller.**
D. **Ink feed control lever.**
E. **Handle for turning fountain roller manually.**

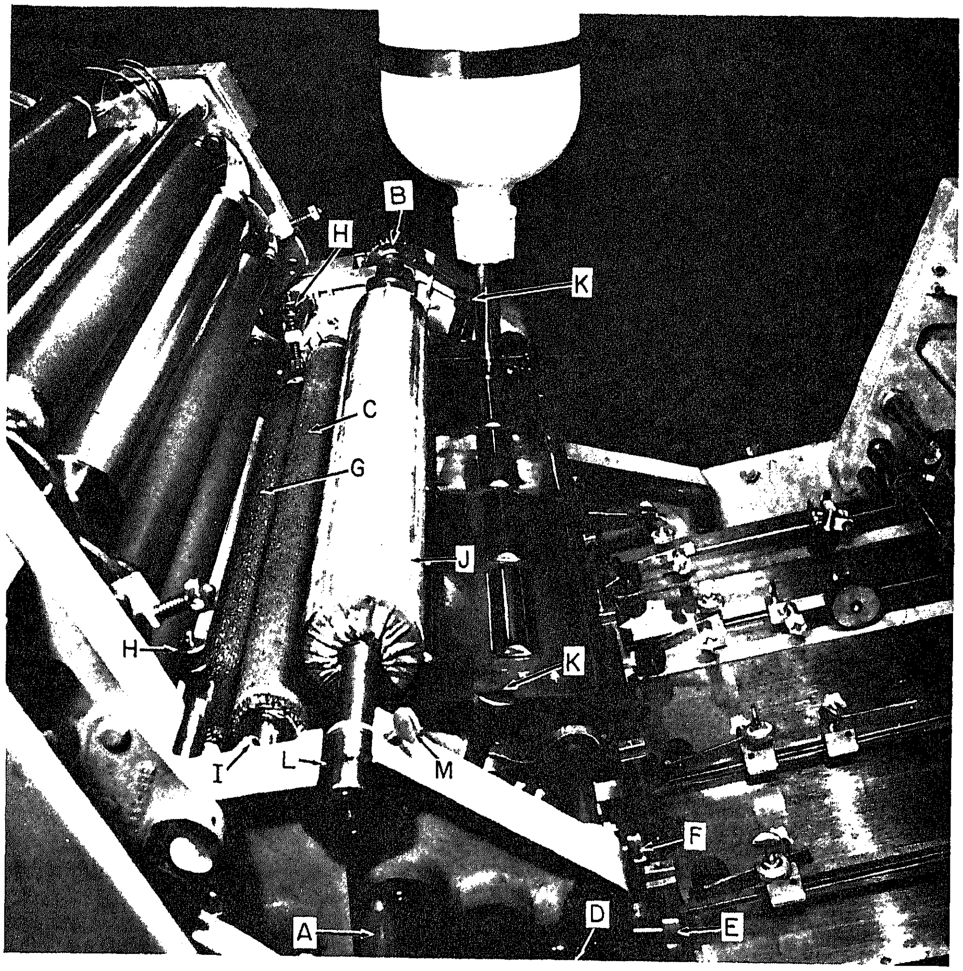
113.432
Figure 14-39.—Washup attachment.

Conventional Dampening System

These presses can be equipped with conventional dampening systems which have two form rollers, one vibrating roller, one ductor roller, and one fountain roller. The lower form roller is slightly larger than the upper one. These rollers are similar to those found on other offset presses.

You can move the dampener form rollers to or away from the plate with the handle shown in figure 14-40. The drive gears remain in mesh when the dampening rollers are moved (racked) back from the plate so that the water fountain continues to operate when the press is operating.

The fountain solution (water) supply to the dampening form rollers is regulated by the length of time the ductor roller contacts the fountain roller. You should push the ductor roller knob all the way in and turn it clockwise to decrease the supply of fountain solution. To increase the supply of fountain solution, push the knob all the way in and turn it counterclockwise. You can pull out on the spring plunger and move the ductor knob all the way out to shut off the supply of fountain solution completely.



A. Handle for moving dampener form rollers to and from the plate.
B. Drive gears.
C. Ductor roller.
D. Ductor roller knob. Pull out to stop water feed.
E. Spring plunger.
F. Adjusting screw for setting lower form roller to plate.
G. Upper form roller.
H. Adjusting screws for setting upper form roller to plate.
I. Setscrew.
J. Fountain roller.
K. Adjusting screws which regulate pressure between ductor and fountain roller.
L. Slot for fountain roller bushings.
M. Thumbscrews which hold fountain roller bushings in place.

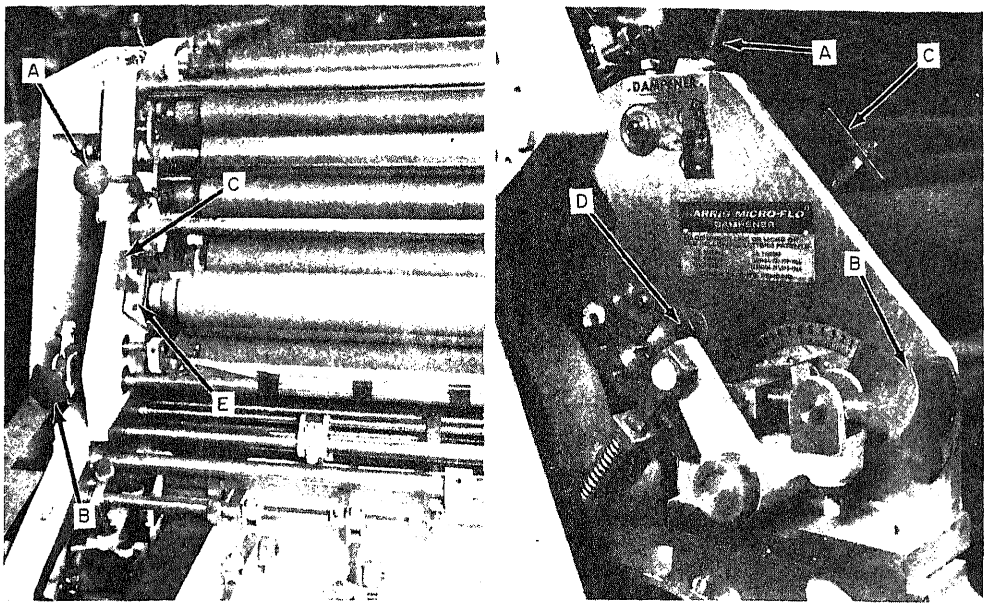
113.385

Figure 14-40.—Conventional water fountain adjustments.

Micro-flo Dampening System

These presses can be equipped with the micro-flo dampening system that have only three rollers: an oversized form roller, a metering roller, and a fountain roller. This form roller distributes ink as well as fountain solution (water) to the offset plate. When the press is in operation, the chrome fountain roller picks up a thin film of fountain solution and carries it to the metering roller (which acts as a squeegee, squeegeeing off all but the desired amount of the solution), and then transfers the solution to the form roller. The form roller, in turn, deposits the moisture on the non-image area of the plate.

You can move the dampening form roller to or away from the plate with the lever shown in



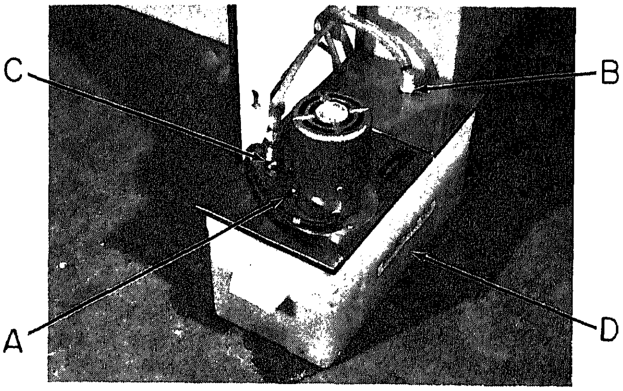
A. Lever used in moving dampener form roller to or from plate.
B. Knob which controls the speed of the fountain roller.
C. T-handles used in setting pressure between the metering roller and the fountain roller.
D. Screw which secures metering roller hangers to press frame.
E. Metering roller hanger. Loosen screw (D) and move hanger so metering roller will be out of parallel with the fountain roller if necessary.

113.386

Figure 14-41.—Dampener controls on press equipped with a micro-flo dampener.

figure 14-41. You can use the T-handles in selling the pressure adjustment at each end of the metering roller to regulate the thickness of the film of fountain solution carried from the fountain roller. The screw which secures the metering roller hangers can be loosened to move the roller when setting the metering roller parallel with the fountain roller. You may also angle the metering roller so that the fountain solution will run heavier on one part of the plate than on another. (More water is run on the sides of the plate as the skew of the metering roller is increased, and more water is run in the center of the plate as it is decreased.)

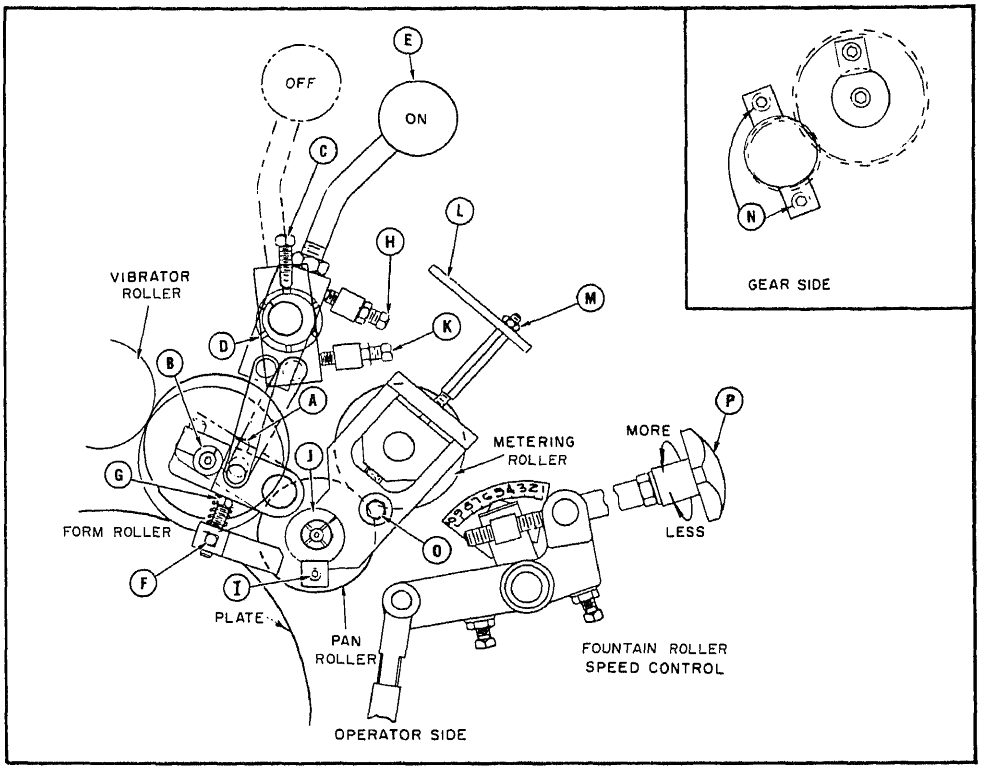
The setting of the metering roller and the rotation speed of the fountain roller control the amount of fountain solution that is fed to the plate. You can regulate the speed at which the fountain roller rotates with the knob shown in



A. Toggle switch for starting and stopping the pump.
B. Distributor tube.
C. Overflow tube.
D. Reservoir tank.

113.387X

Figure 14-42.—Circulating system fountain reservoir.



A. Screw. Loosen when setting form roller to vibrator eccentric.
B. Vibrator roller eccentric. Set with mark at 1 o'clock position on near side and at 11 o'clock position on far side of press.
C. Screw. Loosen when setting form roller to plate eccentric.
D. Plate eccentric. Set with mark at 10:30 o'clock position on near side and at 1:30 o'clock position on far side.
E. Handle for moving form roller to or from plate.
F. Mounting pin.
G. Screw. Head should contact form roller hanger with slight pressure.
H. Stop screw for handle (E).
I. Screw. Loosen when setting fountain roller to form roller eccentric.
J. Fountain roller eccentric. Set with mark at 4 o'clock position on near side and at 8 o'clock position on far side.
K. Stop screw for handle (E). Adjust so that form roller is five-sixteenths inch above plate in off position.
L. T-handle which regulates pressure between metering roller and fountain roller.
M. Nut. Loosen to reposition T-handle without disturbing original setting.
N. Screw located on far side of press. Loosen when setting drive gear backlash.
O. Screw which holds metering roller hanger to press frame. Loosen when skewing roller.
P. Fountain roller speed control knob.

113.388X

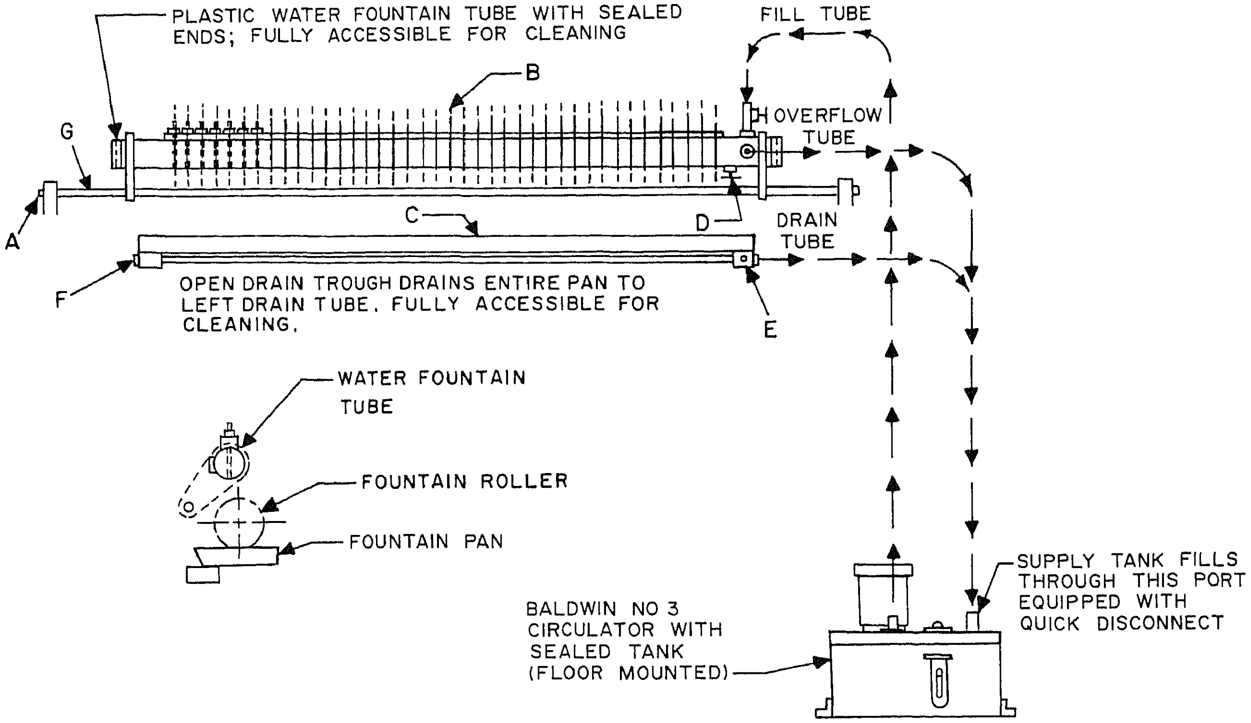
Figure 14-43.—Diagram showing adjustments for micro-flo dampening rollers.

figure 14-41. Do not turn this knob if the dampener form roller is not rotating.

Circulating System

The micro-flo dampener includes a system for circulating the fountain solution. It consists of a reservoir tank for the solution, a pump, a distributor tube running to the fountain, and an overflow tube running from the fountain back to the tank. You can turn the pump off and on with the toggle switch shown in figure 14-42, but you should leave it on at all times when the press is running. The level of solution in the fountain should be such that one-eighth inch of the fountain roller is immersed in the solution.

At the beginning of each day, you should check the solution level in the reservoir tank and add more if necessary. Place the overflow tube in the fountain pan, and then turn on the pump. Bring the metering roller into contact with the fountain roller by turning the T-handle shown in figure 14-43 one turn clockwise. Run the press at


PLASTIC WATER FOUNTAIN TUBE WITH SEALED ENDS; FULLY ACCESSIBLE FOR CLEANING
FILL TUBE
B
G
OVERFLOW TUBE
A
C
D
DRAIN TUBE
F
OPEN DRAIN TROUGH DRAINS ENTIRE PAN TO LEFT DRAIN TUBE. FULLY ACCESSIBLE FOR CLEANING.
E
WATER FOUNTAIN TUBE
FOUNTAIN ROLLER
FOUNTAIN PAN
SUPPLY TANK FILLS THROUGH THIS PORT EQUIPPED WITH QUICK DISCONNECT
BALDWIN NO 3 CIRCULATOR WITH SEALED TANK (FLOOR MOUNTED)

A. Socket screw.
B. Needle valves.
C. Fountain pan.
D. Drain cock.
E. Drain connection.
F. Pipe plug.
G. Tube support rod.

113.390X

Figure 14-44.—Schematic diagram of the nonsplash water fountain.

idling speed to ink the rollers and set the fountain roller speed control knob shown in figure 14-43 to the No. 7 position. Adjust the metering roller to the fountain roller if necessary. Run a few sheets, then reduce the fountain roller speed until the non-image areas of the plate start to fill in with ink. The gradual accumulation of ink in the non-image areas should be even on both sides of the plate. If it is not, you should adjust the metering roller to the fountain roller as necessary.

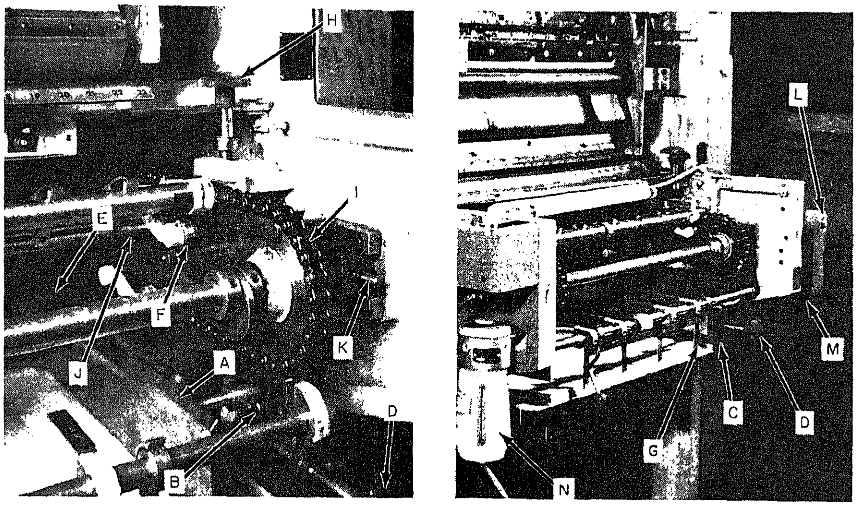
Fountain Solution

The fountain solution formulas for both of these dampening systems can be found in the formula (appendix II). In the case of the micro-flo system, the use of alcohol in the solution is a safety hazard. You should use only a suitable alcohol substitute.

Nonsplash Water Fountain

Aboard ship, presses are sometimes equipped with a special nonsplash water fountain which keeps the fountain solution from splashing out during rough weather. When using such a unit, you should keep the supply tank filled to the proper level, but do not fill it above the level line in the tank.

You can regulate the amount of fountain solution delivered from the plastic water fountain tube to the fountain roller by adjusting the needle valve in the plastic tube. (See fig. 14-44.) Each of the needle (screw) valves should be set to feed one drop of fountain solution to the fountain roller per second. They do not control the water supply to the plate; they simply keep the fountain roller wet, just as if the roller were immersed in the fountain pan. Unused fountain solution will return from the fountain pan to the supply tank through the drain tube, while the unused solution



A. Jogger.
B. Thumbscrew. Loosen to move jogger (A).
C. Thumbscrew. Loosen to turn knob (D).
D. Knob used for moving rear jogger (E).
E. Rear jogger.
F. Sheet releasing cam.
G. Delivery gate.
H. Adjusting knob that controls position of cam (F).
I. Delivery chains.
J. Gripper bar.
K. Adjustable spring rods control tension on delivery chains.
L. Handle for raising and lowering delivery platform manually.
M. Switch which allows table to lower automatically when press is operating provided handle (L) is pulled out.
N. Offset spray.

113.391

Figure 14-45.—Delivery unit of press.

from the water fountain tube returns through the overflow tube.

By opening the drain cock at the far end, as shown in figure 14-44, you can drain the water fountain tube; you can clean the entire tube by removing the cap screws which form the ends of the water fountain tube.

When it is necessary to remove the fountain or fountain roller, you can swing the entire tube assembly back by loosening the socket screw at the end of the tube support rod. You must disconnect the drain connection before attempting to remove the fountain pan.

You may clean the stainless steel drain tube that is connected to the bottom of the fountain pan by removing the pipe plug and the drain connector that is located at the ends of the fountain pan. Drain and flush out the supply tank three or four times a year.

WASHUP

At the end of the day, wash the ink rollers. When you shut off the pump, the fountain solution will drain from the fountain back into the tank automatically.

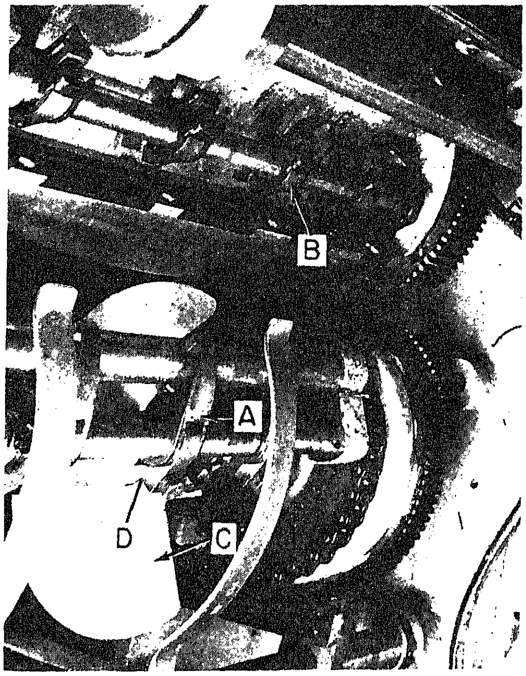
Go over the metering roller with a sponge moistened with a 50-percent gum solution, and operate the press at idling speed until the fountain roller is covered with the gum solution. To keep the metering roller from becoming flat, you should back it away from the fountain roller by turning the T-handle one turn counterclockwise. Then clean it with a damp sponge.

Check the filter in the supply tank once a day and clean it if necessary; clean the water fountain tube and the circulating system once each week. If the fountain roller picks ink during the run, you can clean it with fountain etch and scouring powder. You should clean the metering roller at regular intervals with acetone or, if you have vinyl rollers, with a half-and-half mixture of acetone and an alcohol substitute.

THE DELIVERY UNIT

The main parts of the delivery unit are shown in figure 14-45. The delivery grippers receive the press sheet from the impression cylinder grippers and deliver them with the image up to the delivery pile. There are three sets of delivery grippers. They are attached to gripper bars extending between two endless delivery chains. These gripper bars are spaced so that one set of grippers is in position to receive the sheet on each revolution of the cylinders.

The delivery chains must be tightened occasionally so that the gripper bars will be held in



A. Delivery grippers.
B. Impression cylinder grippers.
C. Skeleton wheel.
D. Wing nut (hidden). Loosen to move the skeleton wheel (C) sidewise.

113.392

Figure 14-46.—Skeleton wheels.

their proper positions. You can use the adjustable spring rods to tighten the delivery chains. Do not set them too tight, however, as this will cause undue wear.

The delivery skeleton cylinder consists of a series of skeleton wheels of thin metal mounted on a shaft. These wheels support the press sheet as it is carried away from the impression cylinder by the grippers. Sprockets at the ends of the shaft provide the driving power for the delivery chains.

You can reposition or remove the skeleton wheels shown in figure 14-46 to accommodate paper stock of various widths. To move the skeleton wheels, loosen the wing nut and slide the skeleton wheel to the desired position. Tighten the wing nuts securely and check to see that the aligning bracket is properly seated in the groove of the shaft.

As the delivery grippers approach the impression cylinder, a cam on the end of the delivery gripper bar causes the grippers to open to receive the press sheet. As the grippers close, the sheet is held momentarily by both the delivery grippers and the impression cylinder grippers. This is known as the "point of transfer." The impression cylinder grippers then open to release the sheet to the delivery grippers which carry it down around the skeleton cylinder and out over the delivery platform.

When the sheet is over the delivery platform, another cam causes the delivery grippers to open and release the press sheet to the delivery pile. This cam is adjustable for different lengths and thicknesses of stock. You can move the sheet release cam forward or backward with the adjusting knob on the near side of the delivery unit which controls its position. (See fig. 14-45.)

Stripper Fingers

The four stripper fingers shown in figure 14-47 strip the sheet from the delivery grippers and direct it down to the delivery platform. You can move these fingers sidewise as necessary; however, once they are set, it is a good idea not to keep moving them. The fingers should be centered between the grippers and should clear the gripper bars by one-sixteenth inch. After moving the fingers, you must always rotate the press by hand to see that they do not interfere with any of the moving parts of the delivery unit before you operate the press under power.

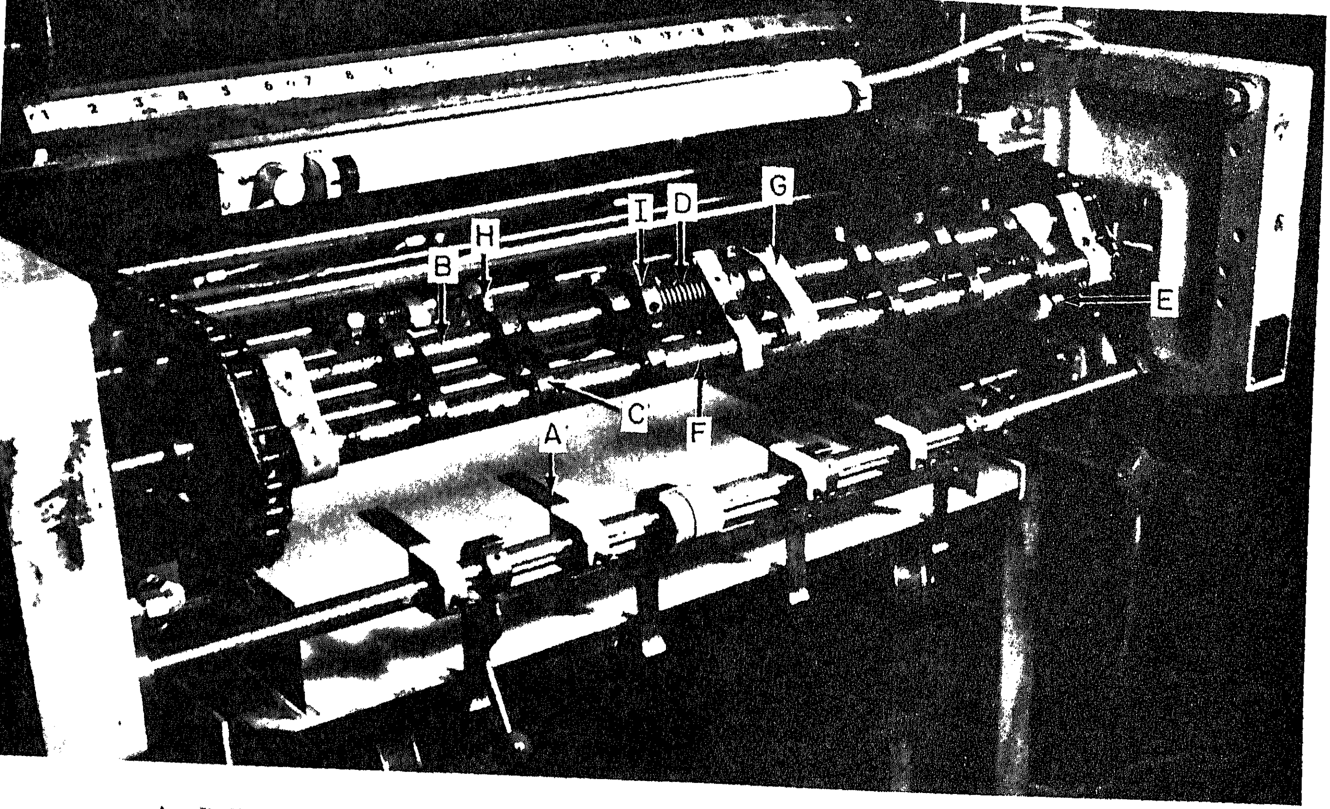
Joggers

To set the joggers, you can crease a sheet of the stock to be run to find its center; align the crease with the centerline on the delivery platform. Then loosen the thumbscrew and move the stationary jogger on the far side of the press up to the edge of the sheet and lock it in place. Inch the press until the near side jogger has moved to the fullest point of its inward movement. Then loosen the thumbscrew shown in figure 14-45 and move the jogger against the other edge of the sheet and lock it in place.

Next, inch the press until the rear jogger is at the end of its inward thrust and loosen its thumbscrew. Then turn the adjusting knob located on the near side in front of the delivery unit until the back jogger contacts the rear edge of the sheet; then retighten the thumbscrew.

Delivery Platform

The delivery platform consists of a dolly supported by lugs. When the press is in operation, the platform lowers automatically. You can also



A. Delivery stripper fingers.
B. Gripper bar.
C. Spring grippers.
D. Master torsion spring.
E. Cam roller.
F. Gripper contact shaft.
G. Master gripper.
H. Cap screws which hold grippers to bar.
I. Collar for adjusting tension on spring (D).

113.393

Figure 14-47.—Delivery grippers.

ise or lower the platform manually with the andle. You should push in on the handle when rning it to raise or lower the delivery platform / hand. If you pull the handle out all the way, e platform will lower automatically when you art and run the press.

The delivery platform will take a stack paper 19 inches high. Once it has reached e floor or is almost to the floor, you can iish lowering it by hand. Then just wheel e load away. Replace the full dolly with another ipty dolly and run it back up into operating sition.

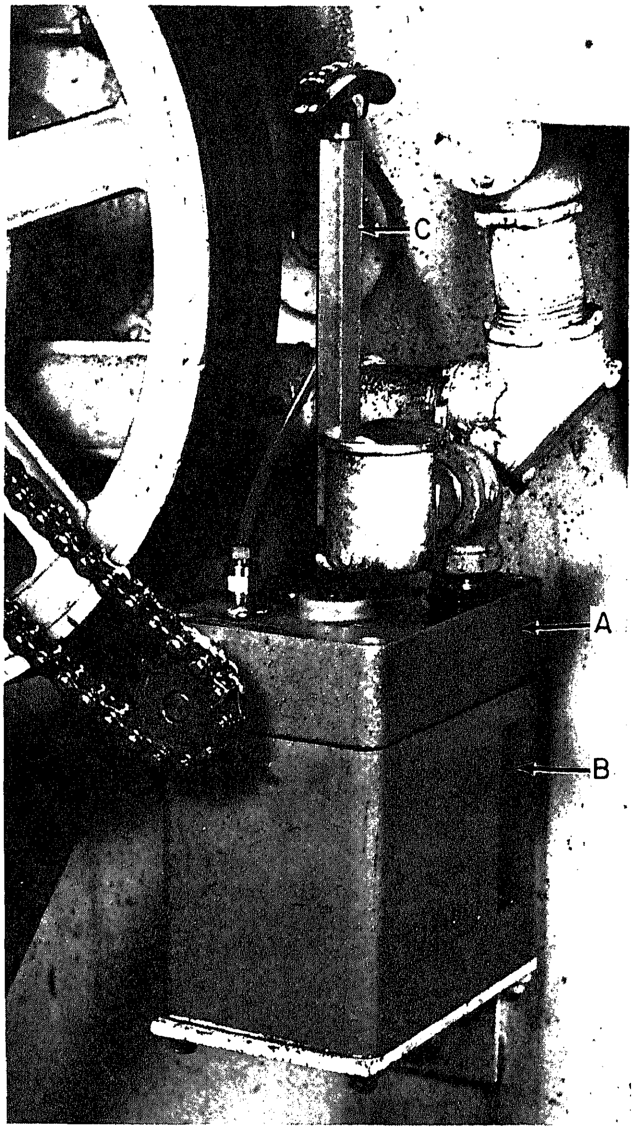
The delivery unit has a clear plastic covering tead of the usual wire guard, which allows nplete visual inspection of the sheet at all ies.

LUBRICATION

The lubrication of this offset press is accomplished in part by an automatic oil pump. However, all presses require manual lubrication. The use of both methods is mutually beneficial and required for the production operation of this press.

Automatic Lubrication

The main bearings of this press are lubricated by an automatic lubrication system. This system consists of an automatic pump, distributor tubes, and metering units which meter or control the flow of oil to the various press parts.



A. **Tank for oil.**
B. **Oil level gauge.**
C. **Plunger.**

113.394
Figure 14-48.—Lubricating pump.

The pump has a tank (reservoir) (see fig. 14-48) which holds 1 pint. This tank should be kept filled. You should check the oil level gauge daily and fill the tank as necessary. Before operating the press at the beginning of each shift, you should lift the plunger and release it to allow it to return to its original position. Lifting the plunger in this manner sends a surge of oil from the tank into the lubricating tubes. When the press is running, the pump operates on pressure. This pressure, which builds up to a peak at 2 minute intervals, then forces oil into the tubes leading to the bearings.

As you can see in figure 14-48, the pump is operated by a chain. This chain runs from a sprocket on the far end of the main drive shaft of the press. The volume of oil and the discharge timing are controlled by a cam-operated mechanism inside the pump which is factory set. This mechanism does not normally require adjustment.

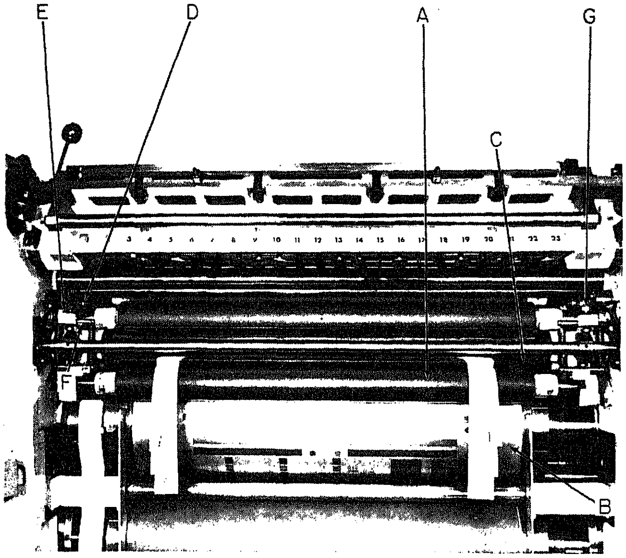
The amount of pressure in the tubes depends on the duration of oil feed to the tubes and on the amount of oil that is permitted to flow through the meter units at the end of the tubes.

You can find the peak pressure by turning the red needle on the pressure gauge to zero. Then, with the press operating, raise the plunger on the pump shown in figure 14-48. As the press operates, a black needle on the pressure gauge will indicate the surges of oil pressure. As the black needle moves, it carries the red needle along with it. However, when the black needle falls, the red needle always remains at the highest reading of the black needle. So, the red needle reading is the peak pressure reading. The black needle on the pressure gauge should be raised to a minimum pressure of 15 psi when the pump is cycling. You should take a pressure reading at regular intervals throughout the day.

Manual Lubrication

You should oil all oil cups and holes requiring manual lubrication at the beginning of each day. Manual lubrication points have been kept to a minimum on the press by the use of self-lubricating bearings whenever possible. For example, the separator and the rear jogger require no lubrication.

You should clean the grease alemite fittings and clean old grease and oil from press parts regularly. The press manufacturer recommends the use of a smooth, short-fiber ball bearing or roller bearing grease of medium consistency (310 to 340 A.S.T.M. penetration worked), soda soap base 327 °F melting point No. 1 N.L.G.I. grade, free from grit, talc, mica, and graphite. Grease fitting should be serviced weekly or after each 100,000 impressions.



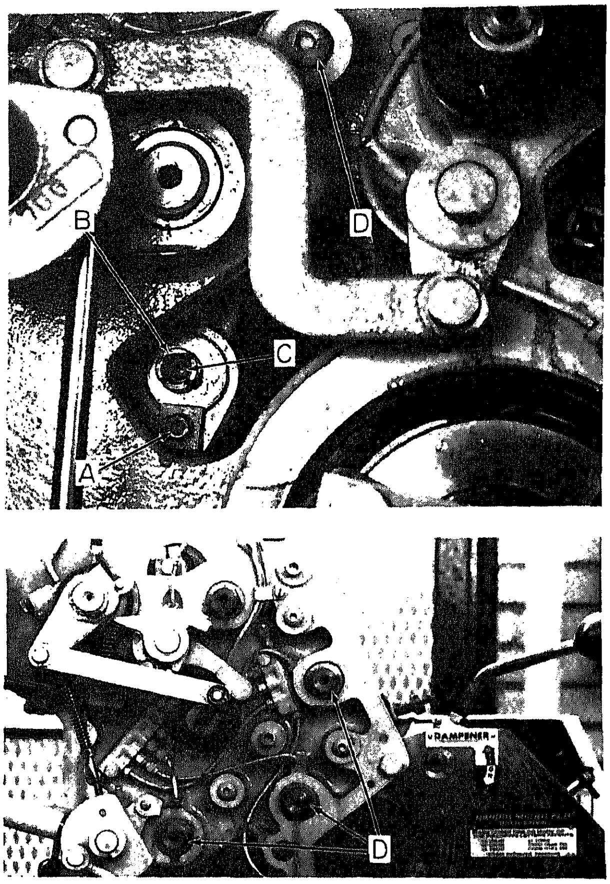
A. Form roller.
B. Plate cylinder.
C. Vibrator roller.
D. Roller bearings which hold distributor rollers in place.
E. Spring-loaded brackets.
F. Mounting pins for distributor roller.
G. Adjusting nut for centering distributor roller. There is one at each end of roller.

113.397X

Figure 14-49.—Ink rollers.

You should apply grease to the ends of rollers and cam surfaces not equipped with oil holes or bearings daily. You should apply the same type of grease to the spur gears that you use for the bearings, but you should apply it to the gear faces more frequently. You should also apply a small amount of bearing grease to the impression cylinder gripper opening and closing tumbler pins at the beginning of the day.

Follow the manufacturer's instructions or the instructions included in the press operator's manual for lubricating the vacuum pump and the drive motor.



A. Eccentric clamp screw.
B. Eccentric.
C. Screw in form roller bearing pin.
D. Allen screws. Loosen when centering distributor roller and turn adjusting nuts at both ends of roller.

113.396

Figure 14-50.—Ink roller adjustments.

SETTING THE INK ROLLERS

As you have seen, the 19- by 25-inch Harris offset press can be equipped with four ink form rollers if the press has a conventional dampening system. Of course, the presses will have three form rollers if it is equipped with the micro-flo system. The form rollers vary in diameter, and figures 14-33 and 14-34 show the proper position for each size of roller.

Two of the distributor (vibrator) rollers are held in position by the small roller bearings shown in figure 14-49 on the ends of the spring-loaded brackets. When installing a roller, you should lift the brackets until there is room to insert the ends of the roller against the mounting pins. When you release the brackets, they will hold the roller in position. To center the roller, you should loosen the Allen screws shown in figure 14-50 and turn the adjusting nuts shown in figure 14-49 at both ends of the roller. Approximately one-sixteenth inch of end play should be maintained in the roller setting.

One of the intermediate rollers is held in place against two steel vibrators by the center friction roller which is set with eccentric pins using strips of paper (feelers) placed between the rollers. You can feel the pressure as you pull on the feelers. Moving the eccentric pin changes the pressure.

The 1 11/16-inch steel rider shown in figures 14-33 and 14-34 can be installed through an opening in the inking unit frame on the near side of the press. Use the steel strainer plate at the top of the rider hanger to lock the roller shaft in position. This roller requires no adjustment.

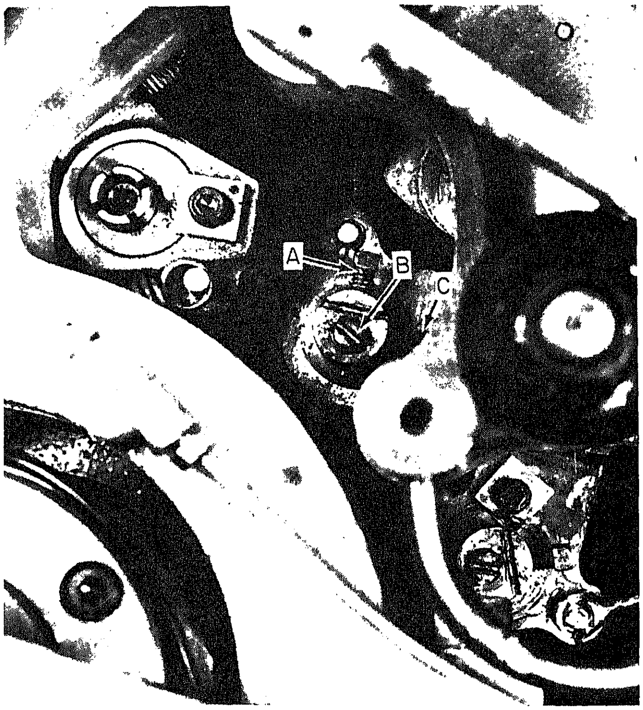
To prepare for the installation of the ductor roller, you should loosen the setscrews in the bearing holders for the ductor roller shaft. Then move both bearings toward the frames. Install the ductor roller in the bearing on the far side and slip the near side bearing into the roller. Center the mounting pins and roller and tighten the setscrews. You can remove end play by moving either the bearing pin holders in towards the center of the roller.

You can parallel the ductor by adjusting the socket setscrews in the lower portion of the ductor roller mounting levers. A small spring in the ductor lever support prevents vibration when the ductor roller moves toward the vibrators. The ductor should be set to the steel vibrators and paralleled. This contact is controlled by the ductor operating cam. The ductor returns to the inker roller because of spring action. The fountain roller has been paralleled at the factory and therefore needs no adjusting by the press operator.

SETTING CONVENTIONAL DAMPENERS

You should mount an offset plate and the proper amount of packing on the press before you adjust the dampening rollers. Then you should rotate the press until the plate cylinder gap is facing the dampeners before you install the form rollers.

Install and adjust the lower form roller first. You can install it by loosening the lock screw shown in figure 14-51 and turning the adjusting screw counterclockwise far enough to allow you to insert the roller journal in the bearing on the far side of the press. Then turn the adjusting screw in the opposite direction and insert the other end of the roller journal into the bearing on the near side of the press. Continue turning the adjusting screw clockwise until the journal of the roller is entirely within the bearing. Do not force it, as this might damage the hangers. Place paper feelers approximately 0.004 inch thick between the form roller and the vibrator roller. Then loosen the Allen screw and turn the adjusting screw until each paper feeler is held with an even, light drag. Then retighten the Allen screw to lock in your setting.



A. Lock screw.
B. Adjusting screw.
C. Allen screw.

113.399

Figure 14-51.—Dampener roller adjustments for presses equipped with conventional dampening systems.

Rotate the press to bring the offset plate under the lower form roller and place feeler strips between the lower form roller and the plate. Move the lower form roller against the plate and adjust it by turning the adjusting screws for setting the lower form roller to the plate. Keep adjusting this screw until you have a even, light drag on both feeler strips.

Next, install the upper form roller in a similar manner. Then place paper feeler strips between this roller and the plate. With the feeler strips in position, move the upper form roller against the plate. You can use the adjusting screws for setting the upper form roller to the plate in the same manner as you did for the lower form roller. Again, keep adjusting this form roller until you have the same results as on the lower form roller.

Ductor Roller

To install the ductor roller, loosen the cap screw and move the bearing holder to the near side of the press. Insert the far end of the ductor roller into the hanger; then slip the near side bearing holder into the ductor. Center the ductor roller in relation to the grooves in the bearing holder shank and tighten the setscrew.

To engage the ductor, you should push in on the ductor roller knob. Place paper feelers between the ductor roller and the fountain roller. Next, rotate the press until the ductor roller cam is on the high dwell of the cam located under the dampener fountain. Note the position of the ductor roller as it moves toward the fountain roller. If it contacts the fountain roller tightly before the cam roller reaches the high point of the cam, adjust it with the adjusting screw.

Place paper feelers between the ductor and the fountain roller and turn the adjusting screws to obtain a light, even drag on both feelers. No adjustment is required between the ductor and vibrator as these rollers are held together with spring pressure.

Fountain Roller

The fountain roller bushings are held in slots in the press frame by setscrews. When installing the fountain roller, you should ensure that the gear meshes with the spiral gear in the fountain roller drive mechanism. Turn the fountain roller bushings so that the oil holes are up and tighten the thumbscrews which hold the fountain roller bushings in place.

SETTING MICRO-FLO DAMPENERS

The setting of the rollers on presses having a micro-flo dampening system varies somewhat from the procedure just described. In order to set these rollers, you must ink the press rollers and mount a properly packed plate on the plate cylinder.

Move the form roller away from the plate and operate the press until the rollers are inked. Stop the press for about 15 seconds, then jog the press until the stripe created by contact between the form roller and the ink vibrator roller is visible. This stripe should be three-eighths inch wide. If it is not, you must turn the vibrator roller eccentric screw to adjust it. All eccentrics are marked on their high points. Turning them counterclockwise on the near side of the press (or clockwise on the far side) creates more pressure between the rollers.

Next, move the form roller against the plate and check the stripe it produces. This stripe should be three-sixteenths inch to one-fourth inch wide and even from end to end. If an adjustment is necessary, you can make it with the plate eccentric. After this, adjust the screw until its head contacts the form roller hanger. Then give it another quarter of a turn to apply slight pressure and then check the stripe on the plate again.

With the form roller against the plate, turn the fountain roller eccentric until the fountain roller just touches the form roller. (The fountain roller eccentric mark should be at the 4 o'clock position on the near side and the 8 o'clock position on the far side of the press.) Raise the form roller away from the plate and check the stripe created between it and the fountain roller. If the stripe is less than one-eighth inch or more than three-sixteenths inch wide, adjust the fountain roller eccentric as necessary.

Place strips of paper 0.005 inch thick between the fountain roller and the metering roller. Turn the T-handle which regulates the pressure between these rollers clockwise until the feelers are held with a light, even drag. After this turn the handle clockwise a quarter of a turn more. If further adjustment is required when the press is running, you can loosen the nut at the end of the T-handle and move the handle slightly to reposition it without changing the original setting of the roller pressure. The T-handles on each side of the press should be pointing in the same direction after the final adjustment.

Next, release the metering roller hanger by loosening the screw which holds the hanger to the press frame and move it until the metering roller is about one-fourth inch out of parallel with the fountain roller. At this point the screw should be centered in the clearance hole on the near side of the press. The screw on the far side of the press should be at the bottom of the clearance hole.

You can set the drive gear backlash by loosening the screws on the far side of the press which hold the gear assembly in place. Then move the drive gear assembly toward the fountain roller gear until there is approximately 0.005-inch backlash between the two gears. Then retighten the screws to hold the assembly position.

FOR LI1 AND LIC CANDIDATES ONLY

The following information on timing and adjustment is required for LI1 and LIC candidates only. LI3 and LI2 candidates are not required to read this designated section.

TIMING AND ADJUSTMENT

Always latch the feeder latch lever in the first notch and jog the press until the separate unit is in motion before you attempt to make any adjustments to the registering and feeding mechanisms. The adjustments will not be accurate if the feeder is not in operating position.

Timing the Registering Camshaft

The (registering) camshaft normally needs no adjustment unless it is necessary to replace parts because they have become worn or damaged.

To time the camshaft, move the feeder latch lever into the first notch and rotate the press until the shaft starts rotating. Stop when the gripper contacts on the impression cylinder are even with the edge of the register plate as shown in figure 14-52.

Trip off the impression and rotate the press to move the shaft forward. If the timing is correct, the feeder drive pawl will unhook the feeder drive latch as the press is rotated forward. (See fig. 14-53.)

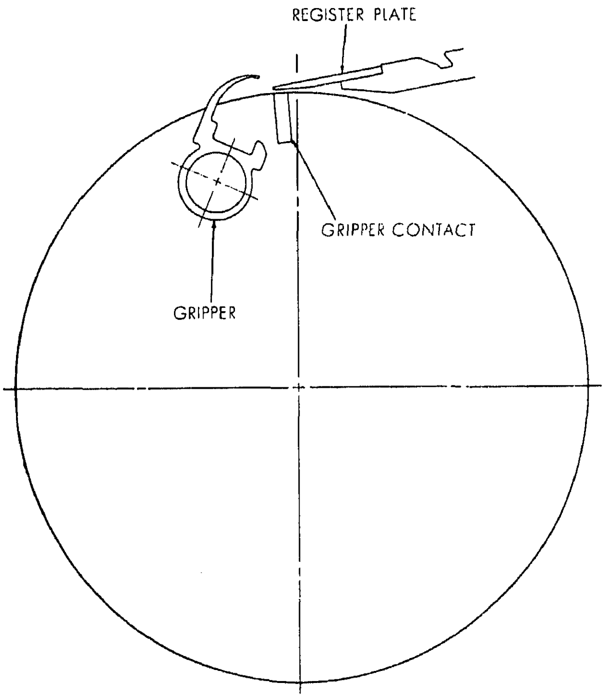


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Figure 14-52.—When timing the registering camshaft, move the press until the gripper contacts are even with the register plate as shown here.

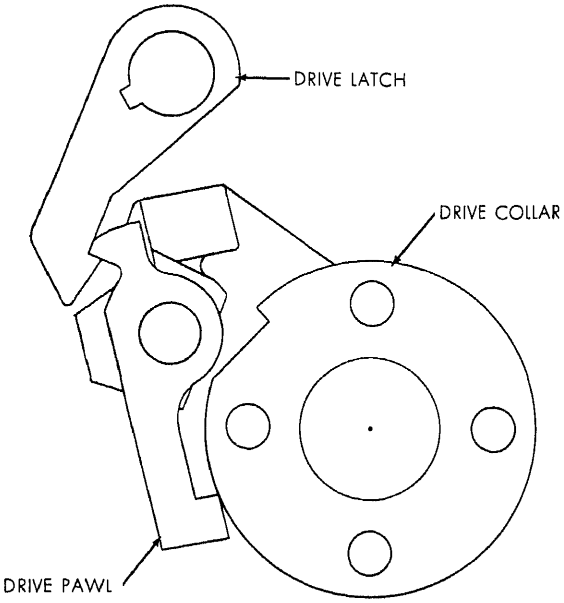

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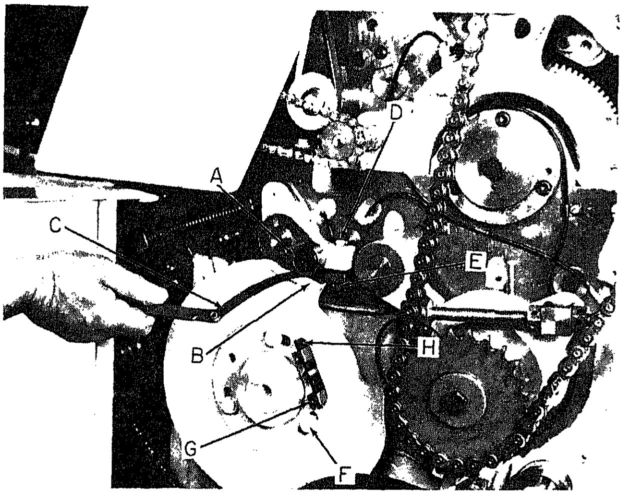
Figure 14-53.—Feeder drive collar.

If it is necessary to retime the shaft, you should latch the feeder latch lever in the first notch and rotate the press until the cylinder gripper contacts are in the position shown in figure 14-52 and the feeder drive pawl is engaged in the drive collar, as shown in figure 14-53. Then disconnect and rotate the camshaft drive chain until there is 1/8-inch to 1/4-inch clearance between the latch and pawl. You should then reconnect the camshaft drive chain without moving the shaft. When you make this adjustment, it is necessary to retime all the cams on the shaft.

Timing the Front Guides

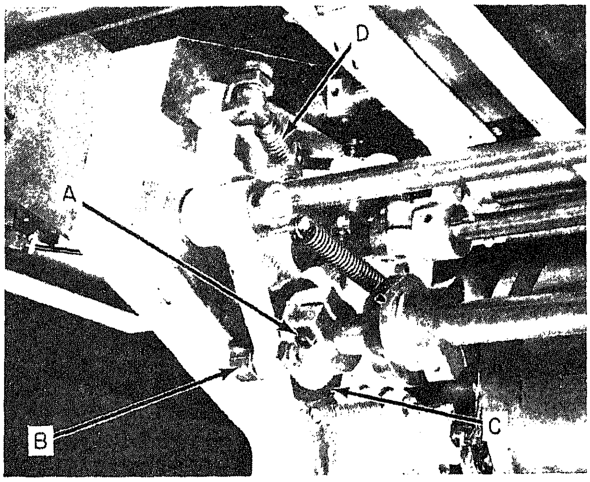
When you are operating the press, the front guide cam shown in figure 14-54 causes the front guides to raise and lower at the proper time. If it is necessary to change the timing of the guides, put the feeder latch lever in the first notch and rotate the press until the cam roller moves into the low dwell of the front guide cam. You will notice that the front guide stop screw prevents the roller from contacting the cam when it is in the low dwell. You should be able to slip a 0.008-inch feeler gauge between the roller and the cam, as shown in the illustration. If necessary, you can



A. Cam roller.
B. Front guide cam.
C. Feeler gauge.
D. Front guide stop screw.
E. Stop block.
F. Cap screws which hold the cam to the hub of the impression cylinder.
G. Allen screws.
H. Adjusting screws for cam (B).

113.402X

Figure 14-54.—Inserting a feeler between the cam roller and the front guide cam.



A. Adjusting screw for side guide cam.
B. Cam roller.
C. Side guide cam.
D. Operating lever spring.

113.403X

Figure 14-55.—The side guide cam.

change the clearance by adjusting the front guide stop screw.

To check the setting, rotate the press until the stop screw contacts the stop block. Try to slip a 0.009-inch gauge between the cam roller and the cam. It should not pass between them. Repeat this process using a 0.007-inch feeler. It should pass between the roller and cam freely.

If it is necessary to adjust the front guide cam, you should place a sheet of paper 0.004 inch thick against the front guides and rotate the press until the impression cylinder grippers start to close on the sheet. Stop the press when the grippers are contacting the sheet but are not completely closed. (They should be exerting a light drag on the sheet, but not be holding it firmly.)

Loosen the cap screws holding the cam to the hub of the impression cylinder and the Allen screws. Then turn the adjusting screws for the cam until the cam just contacts the cam roller. Retighten the screws to lock the cam in this position. Then turn the press forward and watch the front guides as they start to lift. They should clear the edge of the sheet fast enough to prevent it from being damaged as it is pulled into the printing unit.

If you are running heavy stocks, you may find it necessary to advance the front guide cam slightly to keep the edges of the stock from being damaged by the front guides. But if you do, you should return the cam to its original setting before going back to printing on the other paper stock.

If the impression cylinder grippers are not set properly, they will interfere with the adjustment of the front guide cam so always check the setting of these grippers before you move the cam.

Timing the Side Guide

If it is necessary to time the side guide, you should jog a sheet down to the front guides. Then rotate the press by hand, stopping it just as the impression cylinder grippers start to draw the sheet into the printing unit. Loosen the side guide cam shown in figure 14-55 and turn it in the direction of rotation until the side guide is beginning to move away from the sheet. Retighten the cam in this position.

Timing the Corrugating Bar

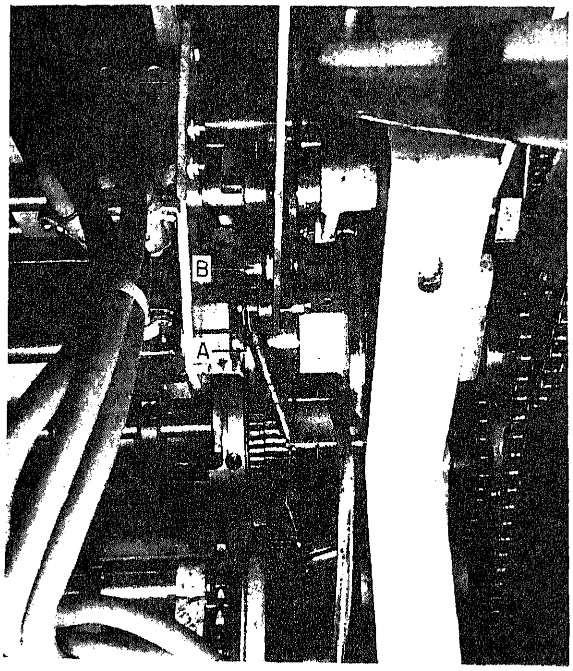
To check the timing of the corrugating bar, you should jog a sheet down to the front guides.

Rotate the press manually until the impression cylinder grippers begin pulling the sheet into the printing unit. The corrugating bar should be raising at this point if it is timed correctly. You can adjust the corrugating bar if necessary by loosening the lock screw that holds it in place on the shaft and turning the adjusting screw in the direction of its rotation until the bar is just starting to raise. Then retighten the lock screw to lock it in place.

You can parallel the corrugating bar to the register plate by loosening the screw that secures the bracket to the shaft on the far side of the press. Adjust it slightly and retighten the screw.

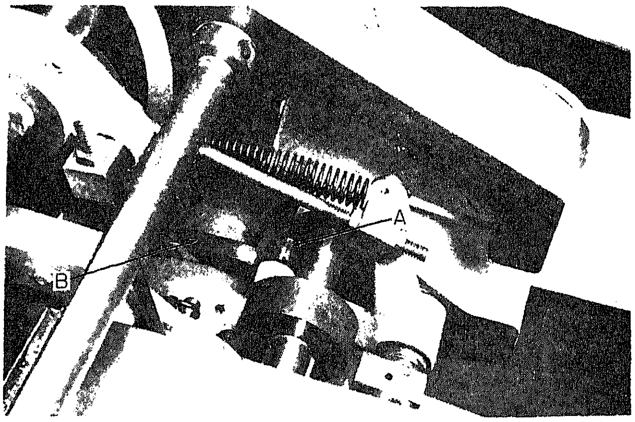
Timing the Caliper (Choke)

To check the timing of the caliper or choke, jog a maximum size (19- by 25-inch) sheet to the front guides. Turn the press manually until the tail edge of the sheet passes under the caliper. The caliper should be in its down position at this point. If it is not, loosen the clamp screw on the cam and turn the cam shown in figure 14-56 in its direction of travel until the caliper drops down.



A. Cam.
B. Cam roller.

113.404
Figure 14-56.—Caliper cam.



A. Cam roller.
B. Sheet detector cam.

113.405X
Figure 14-57.—Sheet detector cam.

Center the cam to the cam roller and retighten the clamp screw.

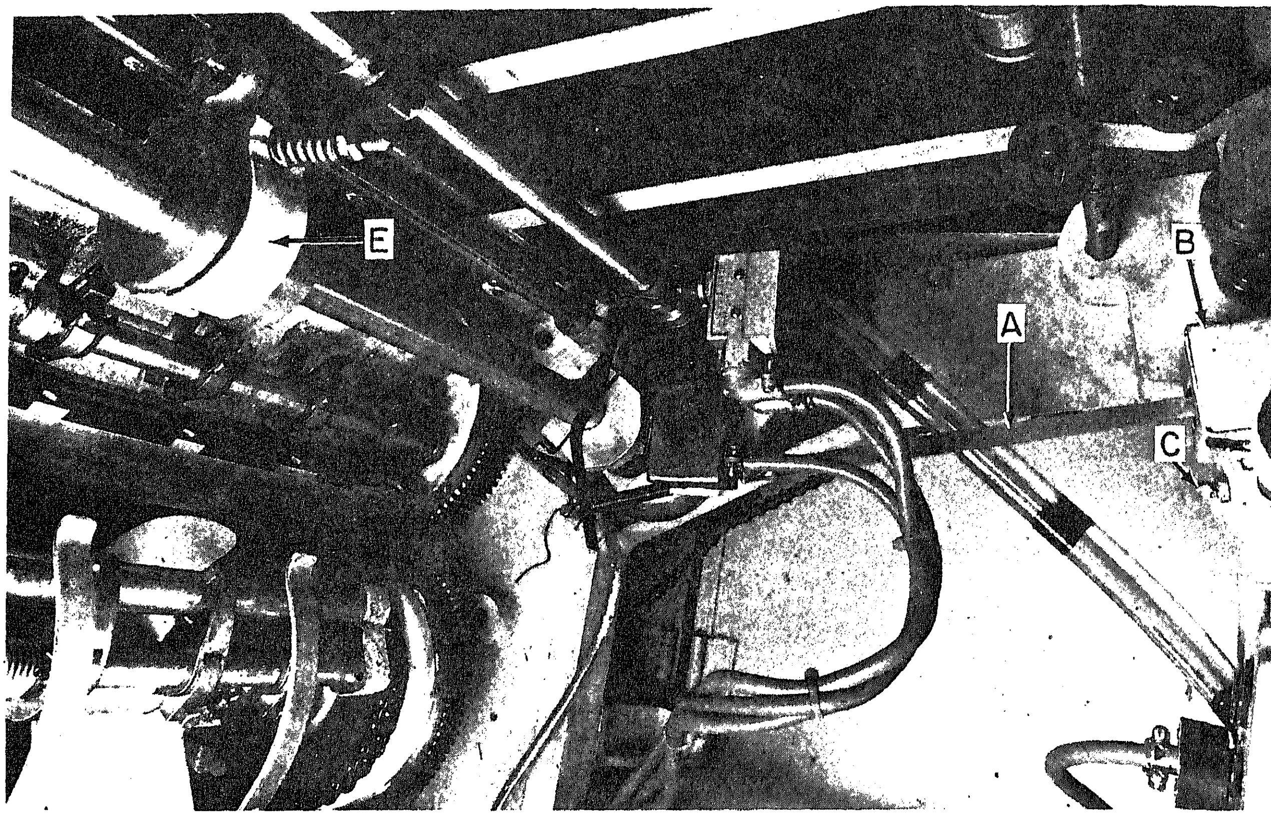
Sheet Detector Adjustment

The sheet detector is factory set and requires no further adjusting unless the contactor is bent or damaged. Always make sure that the front guides are parallel and properly adjusted before you attempt to adjust the sheet detector.

To adjust the contactor, put the feeder latch lever in the first notch and jog the press until the cam roller shown in figure 14-57 is in the low dwell of the sheet detector cam and the contactor is contacting the undertongue on the register plate. Then place a piece of paper against the front guides and see that the contactor is resting on the paper. Next, loosen the setscrew holding the detector tube and slide the detector tube in or out of the holder until the contactor is approximately three thirty-seconds inch in from the gripper edge of the sheet. You can retighten the setscrew to lock in this setting.

If it is ever necessary to replace the contactor or if the electrical lead is faulty, you can remove the detector tube by loosening the setscrew and turning the knurled screw until the flat in the screw (inside the base) permits the detector tube to be withdrawn.

To time the detector cam shown in figure 14-57, jog a sheet down to the front guides. Then rotate the sheet detector cam in its normal



A. Plunger.
B. Coil.
C. Solenoid coil mounting bolts.
D. Feeder tie rod.
E. Camshaft brake.

113.

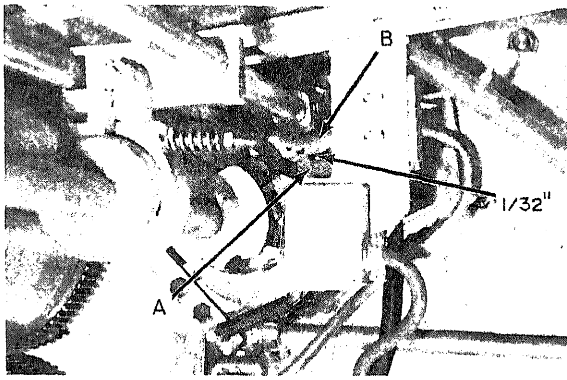
Figure 14-58.—Solenoid linkage.

direction of travel until the contactor drops against the paper.

To check the setting of the detector solenoid linkage, push the plunger shown in figure 14-58 all the way into the coil. (There should then be a clearance of one thirty-second inch between the trip latch shown in figure 14-59 and the outer surface of the collar.) If there is more or less space between them, loosen the solenoid coil mounting bolt shown in figure 14-58 and rotate the coil on the feeder tie rod. When you have obtained the proper clearance, retighten the solenoid coil mounting bolt.

Camshaft Brake Adjustment

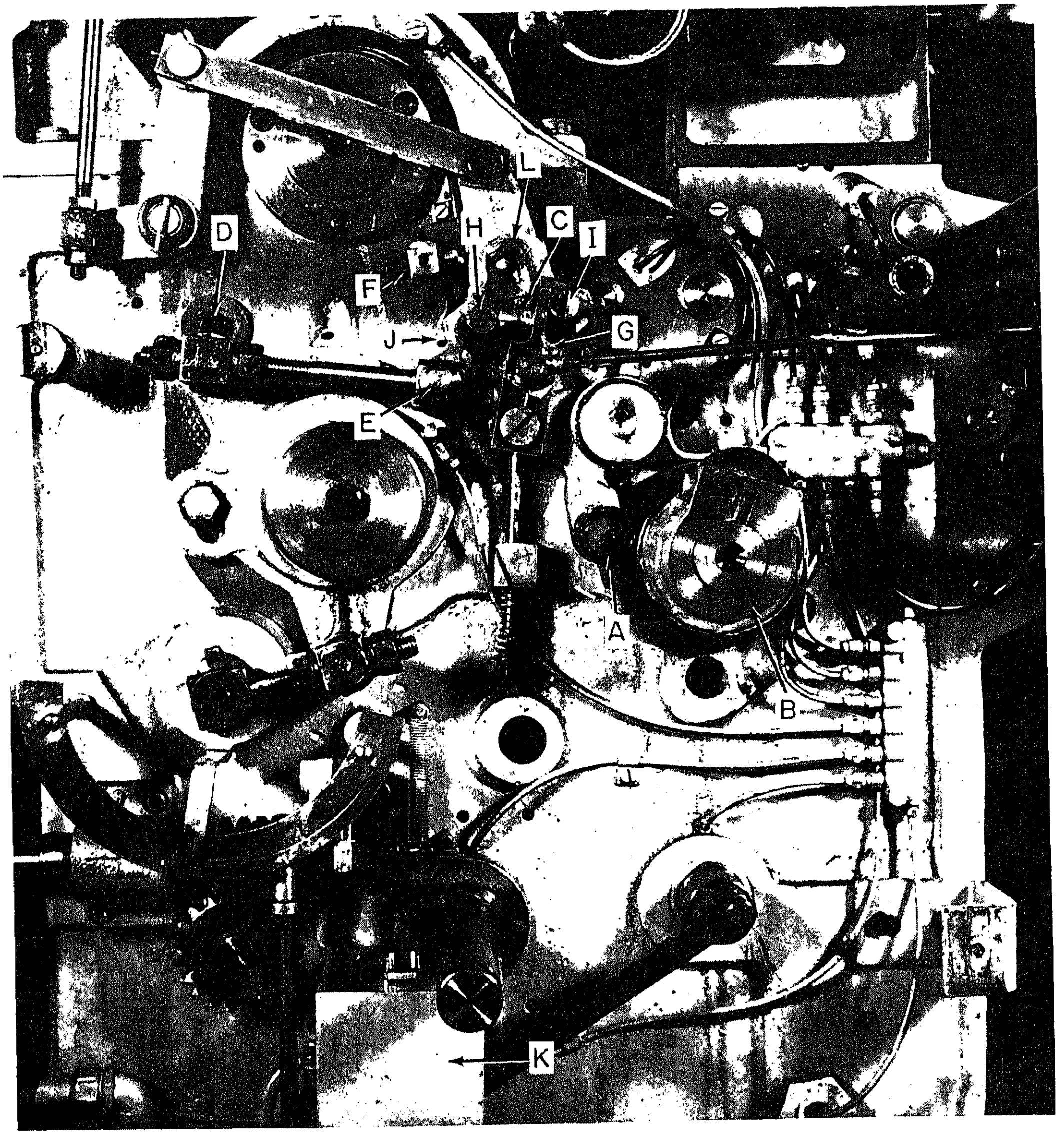
The camshaft brake shown in figure 14-58 will ordinarily need no adjusting. You should keep it clean and free from oil. It should be set with



A. Trip latch.
B. Collar.

113.4

Figure 14-59.—Detector trip latch and collar.



A. **Cam roller.**
B. **Pressure throw-on cam.**
C. **Pivot pin.**
D. **Needle pin in blanket cylinder.**
E. **Fulcrum pin.**
F. **Stop screws.**
G. **Throw-off plunger.**
H. **Eccentric stud in throw-off lever.**
I. **Eccentric stud in throw-off lever.**
J. **Setscrew that secures eccentric stud in position in the lever.**
K. **Solenoid for delivery platform.**
L. **Throw-off operating lever.**

113.408

Figure 14-60.—Pressure toggle adjustment.

enough tension to keep the camshaft from coasting when the cam rollers are on the low dwell of the cams. If it becomes worn or dirty, the feeder tapes will operate with an irregular motion which may cause register troubles. The brake is usually warm when the press is operating, but it should not be excessively hot.

Pressure Toggle Adjustment

When the press impression is on, the throw-off plunger shown in figure 14-60 is forced against the eccentric stud. This moves a connecting rod to shift the blanket cylinder eccentric into the on position. The throw-off operating lever serves as a toggle which locks the plate and blanket cylinders together while the impression is on. The toggle mechanism is factory set and requires no adjustment unless it becomes worn or a part must be replaced. If it is not adjusted properly, of course, the pressure between the plate and blanket will not stay on during the run.

To check the toggle setting, you should clean the cylinder bearers thoroughly, then move the blanket cylinder into contact with the plate by latching the feeder latch lever into the second notch and holding it in this position. Turn the press until the cam roller moves onto the high part of the pressure throw-on cam. Then extend a straightedge or stretch a piece of string from the center of the pivot pin to the center of the needle pin in the blanket cylinder eccentric. The center of the fulcrum pin should be approximately one-sixteenth inch beyond the string or straightedge.

If adjustment is required to obtain the 1/16-inch dimension, back off the stop screws so that they will clear the throw-off lever regardless of whether the impression is off or on. Jog the press with the feeder latch lever in the second notch until the cam roller is again on the high dwell of the pressure throw-on cam and check the 1/16-inch dimension. If it is off more (or less) than the one-sixteenth inch, rotate the press to move the cam roller to the low dwell of the pressure throw-on cam and release the throw-off plunger by tripping off the feeder latch lever. The location at which the center of the fulcrum pin stops in relation to the straightedge or string is controlled by the throw-off plunger and the eccentric studs in the throw-off lever.

You can make a small adjustment by turning these studs. Mark the position of a stud that moves the pressure on. (The mark will show how much the stud is moved.) Loosen the setscrew to release the stud and turn the stud down toward the throw-off plunger to increase the throw. Then retighten the setscrew.

Turn the press slowly until the throw-off plunger comes into contact with the stud and the fulcrum pin is moved up. If the center of the fulcrum pin goes more than one-sixteenth inch past the string or straightedge before the cam roller reaches the high point of the pressure cam, the stud was lowered too much. Then you must move it back up to reduce the plunger push. Reset the stud and recheck for the 1/16-inch dimension.

When you change the height of the plunger in relation to the eccentric stud in the throw-off lever, you can also change it in relation to the other eccentric studs. To check the clearance between the plunger and the pressure off stud, release the feeder latch lever so that the plunger will move to the off position when the press is rotated and the cam roller goes into the low dwell of the cam. The throw-off plunger should clear the stud and move under it freely. If it does not, adjust the stud until it does. Put the press back on impression and check to see that the plunger clears both studs by the same amount of space.

Rotate the press until the cam roller is on the high dwell of the pressure throw-on cam and set the on side stop screw so there is 0.005-inch clearance between it and the throw-off operation lever. Jog the press to release the impression pressure, and stop the press when the cam roller is in the high dwell of the cam. Set the off side stop screw to the same clearance between it and the throw-off operating lever.

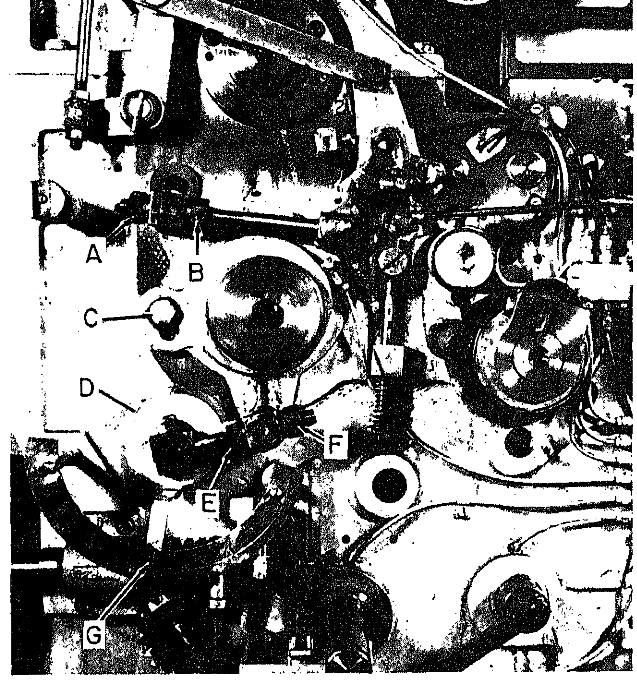
Cylinder Adjustment

You can adjust the pressure (squeeze) between the plate and blanket cylinder bearers and parallel the cylinders at the same time.

First, remove the plate and blanket from their cylinders and loosen the lock screws (holding the backlash gear) to release the backlash gear. Then rotate the press until the plate and blanket cylinders are halfway through the printing cycle. Then put on the printing pressure by moving the feeder latch lever to the second notch.

Next, loosen the pressure-adjusting nuts shown in figure 14-61 to release the pressure between the cylinder bearers. You can reduce the pressure on the near side by loosening the left nut and tightening the right. Reverse this process on the far side of the press.

Back off the blanket cylinder enough to enable you to insert a 0.006-inch feeler gauge between the bearers of the two cylinders and tighten the adjusting nuts until there is an even drag on both feelers. Once the cylinders are parallel, replace the 0.006-inch feelers with 0.004-inch feelers and turn the pressure-adjusting nuts until the pressure is even on the 0.004-inch feelers. Make a note of the faces on the head of the nut you had to turn the pressure adjusting nuts to move the cylinders the required 0.002 inch. Multiply this by three to find the number of faces you must still turn the nuts to bring the cylinders into contact and provide the additional 0.002-inch printing pressure. (As you will see, you should do this later, after you have paralleled the blanket and impression cylinders.)



A. **Pressure adjusting nut.**
B. **Pressure adjusting nut.**
C. **Cap screws.**
D. **Pressure adjusting capstan.**
E. **Adjusting nut.**
F. **Adjusting nut.**
G. **Dial pointer for setting impression cylinder pressure.**

113.409

Figure 14-61.—Adjustments for regulating the squeeze between the blanket and impression cylinders.

To parallel the blanket cylinder to the impression cylinder, you should loosen the cap screws shown in figure 14-61 on both sides of the press. Put on the printing pressure and insert a 0.015-inch feeler gauge between the bearers at each end of the two cylinders. Next, to increase the pressure, slip the detachable handle into the hole provided and move the pressure adjusting capstan shown in figure 14-61.

If both feeler gauges are not held with the same amount of pressure, the blanket cylinder is not parallel with the impression cylinder. In this case, you should loosen the adjusting nuts shown in figure 14-61 and turn them as necessary on either side of the press until the 0.015-inch feelers are both held with a firm, even pull.

Once all the cylinders are parallel to each other, you can go back and add the 0.002-inch

After this has been done, check the 0.015-inch clearance between the blanket and impression cylinder bearers, and if it has not changed, tighten the cap screws. You should throw the impression on and off manually as you check your settings.

Finally, loosen the pressure-adjusting nuts on both sides of the press and move the pressure throw-on handle to set the dial pointer at zero. Retighten the nuts to secure the setting. Once this has been done, you can reset your backlash gear.

Backlash Gear Adjustment

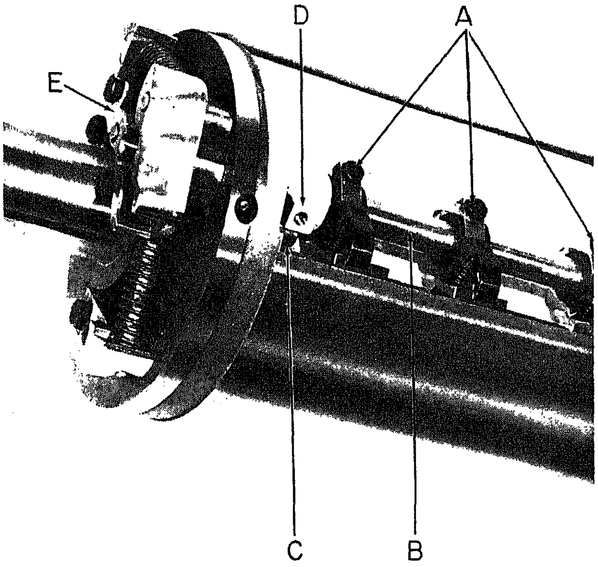
The backlash gear repositions the cylinders before each impression. It is attached to the plate cylinder gear with the three lock screws. Each time you change the pressure between the plate and blanket cylinders, you must reset the gear. To set the backlash gear, you should throw off the impression and loosen the lock screws. Rotate the press until the plate cylinder gap is facing the delivery end of the press. Then slip a pin wrench or bolt in the threaded hole in the center of the plate cylinder and turn the cylinder gear backward to remove any play between the plate and blanket cylinder gears. (Do not apply enough pressure to actually turn the cylinder.) Then, without moving the plate cylinder, turn the backlash gear forward as far as it will go. Tighten two of the lock screws just enough to hold the gear firm, but not enough to keep it from moving when the impression is thrown on.

Remove the pin wrench or bolt from the plate cylinder, move the feeder latch lever to the second notch to throw on the impression, and hold it there while you jog the press for several revolutions. Stop with the printing pressure still on and tighten the three lock screws. Finally release the feeder latch lever and jog the press to throw off the impression.

Setting the Impression Cylinder Grippers

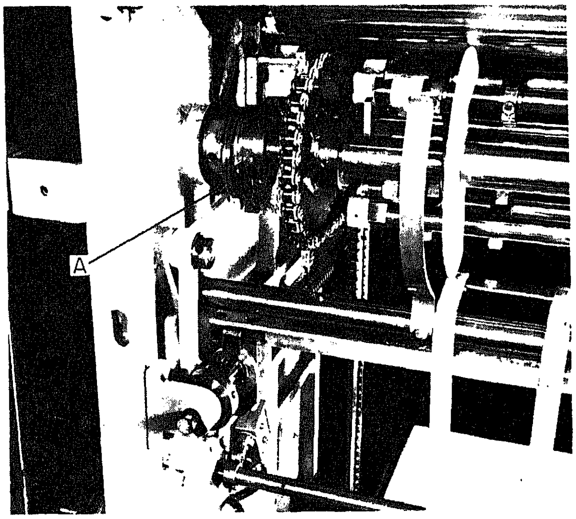
When you are setting (adjusting) the impression cylinder grippers, first, rotate the press until the grippers are open and below the register plate. Then insert a screwdriver in the slot of the tumbler cam shown in figure 14-62 and rotate the shaft until the grippers close. (You will damage the press if you rotate the press while the grippers are closed at this stage of the procedure.)

Mark the location of each gripper on the gripper pad so that you can get it back in its exact



A. Screws which hold grippers to shaft.
B. Gripper shaft.
C. Gripper shaft stop pin.
D. Stop lever.
E. Tumbler cam.

113.410X
Figure 14-62.—The impression cylinder grippers.



A. Timing cam.

113.411X
Figure 14-63.—Delivery joggers.

position. Next, loosen the screws that hold the grippers to the gripper shaft. Place a 0.005-inch feeler gauge between the gripper shaft stop pin and the stop lever. Rotate the press by hand until the feeler gauge is held with a light drag. Then without moving the impression cylinder, place a 0.002-inch paper feeler under each gripper and set each gripper to a light tension on the feelers.

Check to see that the proper tension is maintained on the 0.005-inch feeler gauge between the stop pin and stop lever. After you set the grippers, remove the feeler gauge and rotate the gripper shaft to open the grippers again. Then rotate the press manually for one or two revolutions and watch to see that the grippers open and close properly and that they do not contact the register plate or the delivery grippers.

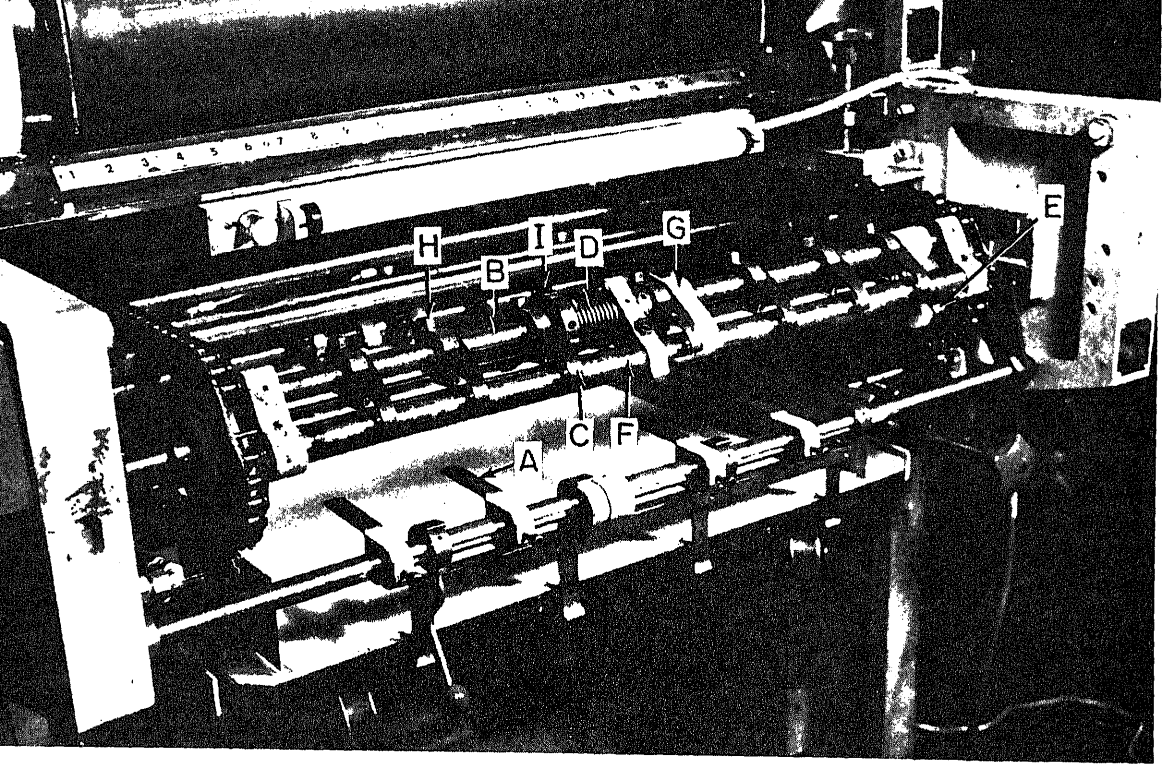
Timing the Delivery Joggers

The delivery joggers should begin to open just as the delivery grippers release the press sheet. If it is necessary to retime them, you should jog the press until the delivery grippers open on one of the delivery gripper bars. Then loosen the timing cam shown in figure 14-63 and turn it forward until the joggers begin their outward thrust. You can then retighten the timing cam in this position.

Setting the Delivery Grippers

In addition to the delivery grippers, each with its individual spring, you will find on each of the three delivery gripper bars a master gripper and a master torsion spring. (See fig. 14-64.) You must maintain sufficient tension on the master spring to compress the individual gripper springs and to hold the master gripper snugly against the gripper contact shaft. The master gripper controls the location of the gripper opening cam roller lever. It should be set so there will be 2 3/8 inches between the bottom of the cam roller and the outside of the gripper contact shaft. This setting should be the same for all the cam rollers on each of the three gripper bars. If it is necessary to change the setting of a cam roller, you should do it before setting the individual grippers.

Do not disturb the setting of the master gripper when you are setting the individual grippers. To set the grippers individually, loosen the cap screws which hold them on the shafts. Then rotate the press until the cam roller is out of contact with the gripper opening cam and slip a 0.015-inch feeler gauge under the master gripper. Center the grippers on their contacts and place a strip of paper 0.002 inch thick under each gripper. Set each gripper to exert a light drag on



A. Delivery stripper fingers.
B. Gripper bar.
C. Grippers.
D. Master torsion spring.
E. Cam roller.
F. Gripper contact shaft.
G. Master gripper.
H. Cap screws which hold grippers to bar.
I. Collar for adjusting tension on spring (D).

Figure 14-64.—Delivery grippers.

113.412

and tighten it on the shaft. After all the
ave been set, replace the 0.015-inch
a 0.020-inch feeler. All paper test strips
se if the individual gripper settings are
inally, remove the feeler gauge and
ee that all the strips of paper are held

ou set the grippers in this manner, it
ssary to reset them when switching from
(thickness) of paper to another because
e working on spring action as they grip

an adjust the tension of the master
ring by loosening an Allen screw and
collar. Pin wrench holes are provided
g the collar. Do not force the collar
master spring; the spring must operate

SAFETY

Adhering to safety practices around any press is essential. Removing safety covers and jury-rigging switches are all good ways for you to perhaps require medical attention. Proper training and frequent reminders such as warning signs may help. Follow all current safety regulations such as *Safety Precautions for Forces Afloat*, OPNAVINST 5100.19A. Ensure that all of your personnel are up-to-date on these safety precautions and you have implemented them in your shop. Remember a four-sided bleed can be painful and costly.

SECURITY

The handling of classified material is an important part of being a Navy Lithographer.

questions will arise as you work with classified material. The *Department of the Navy Information and Personnel Security Program Regulation* (OPNAVINST 5510.1G) contains the current guidelines in all these areas. You should become familiar with this instruction before handling classified material.

In addition, you should always clean the blanket and impression cylinder after running classified material. Pick up all waste and check your press to ensure that no printed sheets have fallen down into the press. All to often when we work with classified material on a regular basis, we can perhaps become complacent. This you must avoid. Security training should be a part of your regular training program.

MAINTENANCE

A good maintenance program is essential for any lithographic shop. This will ensure longer machine life, more operational time, and higher quality work.

If you are onboard ship, your presses will have a maintenance coverage package. This coverage is known as the 3-M Planned Maintenance System covered by OPNAVINST 4790.4A. This system provides guidelines for performing maintenance, proper maintenance sequence, and documentation. Training and proper use of this system on board ship is mandatory. Its usefulness has been proven time and time again. So use this system to your advantage.

SUMMARY

You were introduced to the 19- by 25-inch Harris offset press. This press is so named because it has a maximum sheet size of 19 by 25 inches. It will also print on a sheet as small as 8 1/2 by 11 inches.

Basically, this press consists of a stream feeder, a conveyor or tape table (feedboard), a registering unit, a printing unit, and a delivery unit.

By turning on the press, then moving the feeder latch lever, you activate the feeder, the tape table, and the registering unit. When you turn on the air and vacuum, the sheets will then start to feed from the paper (feeder) pile. The paper is fed onto the tape table and moves down to the registering unit. After the paper reaches the side commence as the stock is fed into the printing unit. The paper then leaves the printing unit and is carried to the delivery unit and onto a receding stacker.

The 19- by 25-inch Harris offset press has three central panels for starting and stopping the press, vacuum pump, and counter. The stop button has three positions: safe, stop, and ready. You use the safe setting when you secure the press for the night or when you or an assistant are working on or adjusting the press. The ready position is used just before you operate the press.

The maximum press speed is 7,500 impressions per hour. You can vary the speed by adjusting the speed control handle along the indicator scale. If the press trips off of impression, the press will go to its idling speed. After the impression is placed on again, you can bring the press speed back to the speed indicator setting by depressing the speed pedal. Never place the press on impression unless the press is at idling speed. To do so otherwise will change the timing of the press.

You can rotate the press by hand with a detachable handle placed through the hole in the drive shaft. Use this only as needed and be sure to remove the handle before you start the press.

The feeder latch lever has three function positions. The first is to set the feeder in operation, the second is to put the press on impression, and the third is to trip off the feeder and the impression. The third position also slows the press down to its idling speed.

A manual trip button is provided on the delivery end of the press to allow you to stop feeding and take the press off of impression in case of press problems.

The feeder unit consists of a feed table, pile height adjustment, and raising and lowering handle. The function of this unit is to provide stock to the separator unit at the correct height. The separator unit separates the sheets of stock and moves it onto the tape table past the flap shaft and under the forwarding rollers before it releases the sheet.

Once the sheet is under the forwarding rollers, the sheet moves down the tape table through a series of sheet controls until it reaches the printing unit.

The printing unit consists of a plate, a blanket, and an impressions cylinder. Once the sheet of paper is received in this unit, it is printed and released to the delivery unit.

While the printing is being accomplished, the inking and dampening systems are providing ink and water to the plate cylinder for the printing process.

The delivery unit takes the sheet of paper from the printing unit and moves it to the delivery platform where it is stacked one on top of the other.

At the end of each day, you should drain all the fountain solution, remove the ink from the ink fountain, and clean all the ink rollers. Next, you should clean all dirty areas in and around the press before securing.

The lubrication of many of the parts on the 19- by 25-inch Harris offset press is done by the automatic lubricating pump. Always check the oil lever in the tank of the automatic lubricating pump everyday and refill it as necessary. The rest of the press lubrication is done manually and must be done before the start of the workday to ensure the necessary supply of oil to the press parts for your press operation.

The proper operation of the ink and dampening system rollers is essential for quality printing of your final printed product and for maximum plate life. Adjustments to these systems may be infrequent, but they should be made when necessary.

Adjustments from the feeder to the delivery section of the 19- by 25-inch press may be necessary also. You must remember that these adjustments should be performed only when necessary and by qualified personnel. Making unnecessary or improper adjustments can do more harm than good.

As always, your first concern should be safety. Proper use of all safeguards and procedures will ensure better health of the press operator and a longer life of the printing press.

The handling of classified material should be under OPNAVINST 5510.1G. Proper training in this area is essential for Navy Lithographers and good security.

Proper maintenance training of all your equipment is also essential for longer machine life, with better quality in the final product. If you are aboard ship, the full use of the 3-M System, OPNAVINST 4790.4A, is mandatory. The 3-M System has a proven record for achieving its main goal—operational readiness. Therefore you should practice, train, and use the 3-M System.

CHAPTER 15

PAPER AND INK

Paper is the single largest material cost in printing. It can also be the source of a majority of problems to the printer. Paper and ink together are the most influential factors that affect the visual quality of printing.

PAPER

Basically, paper is a thin layer of fibers. Its appearance and usage are affected by the types of fibers used, the method of preparation, the various substances added, and the finishes applied. Most papers are composed of wood fibers, although cotton, flax, hemp, bamboo, grass, and other vegetable fibers may be used. A knowledge of the ingredients and papermaking processes will give you insight into the characteristics of paper and enable you to understand the paper and control it.

Essential to papermaking is the continuous papermaking machine. In the papermaking machine the wood fibers, diluted to about one-half of one percent, are flowed onto an endless wire screen. The screen is agitated as it travels, causing the fibers to align parallel to the direction of travel. As the water drains from the paper, the web (as it is called) of paper is capable of being lifted. The web is passed under felts to remove more water, then over drying rolls to remove almost all of the remaining water. The paper is then treated and smoothed and wound on rolls. These master rolls are later slit, and the paper is rewound on rolls or cut into sheets, as required by the customer.

PAPERMAKING

The process of converting logs and other fibrous substances into paper begins with the manufacture of pulp.

Pulp

There are four general classes of pulp used in papermaking. The first, mechanical (or ground) wood pulp, has the simplest and least expensive process. With the exception of the bark, whole logs (generally pine, spruce, fir, or other softwoods) are shredded and then ground into fine particles. These particles are mixed with water and flowed onto the papermaking machine. An example of mechanical pulp is newsprint.

A second class of pulp is made from old (recycled) paper. The quality of old-paper pulp depends upon the type of recycled paper used. Relatively good pulp may be obtained by using fine quality paper scraps that have not been printed. Poorer pulp is made from mixed, previously printed recycled paper. The recycled paper is cooked with lye to dissolve the ink and reduce the paper to pulp, and with bleaches to whiten the pulp. Better quality recycled paper pulps are similar to the paper stocks from which they were made. Poorer quality pulps are used in making boards such as those used on the back of writing tablets.

A third class of pulp is obtained by grinding and cooking old rags. Cotton and linen rags are the most commonly used, but rag pulp has been made from man-made fibers such as rayon and nylon and from mineral fibers such as asbestos. Unused white rags are the best for pulp, as wear, laundering, and dyeing weaken the fibers. Rag pulp may be used entirely (100% rag papers are the most permanent and are used in legal documents, etc.), or the rag pulp may be mixed with wood pulp (25% rag bond is generally used for Navy letterheads).

The fourth and most widely used class of pulp is derived from the chemical wood process, in which wood chips are cooked in various chemicals to remove unwanted gum, resins, and similar materials. As a considerable amount of these materials is removed in the process, chemical wood pulp requires almost twice the quantity of wood as mechanical wood pulp.

There are several classes of chemical wood pulp. Each class varies according to the chemicals used during processing. Most common is the sulfite process in which the wood chips are cooked in lime and sulfurous acid. Softwoods, such as fir and pine, are used for the sulfite pulp that is used in good grades of book and writing papers.

There is another type of pulp also known as sulfite pulp. In this process either softwoods or hardwoods, such as beech, maple, and oak, are used. The wood is cooked in caustic soda and sulfur. Sulfite pulp is used in the manufacture of kraft paper for grocery bags, and so on. Bleached sulfite pulp is also used in making other papers.

The soda pulp process uses hardwoods that are cooked in caustic soda to remove impurities.

In addition to these processes, there are refinements of the sulfite process which produce even finer grades of paper pulp.

As each type of pulp has its own characteristics, papermakers combine various pulps in differing quantities to produce the great variety of papers in use today. The compounding of pulps and other ingredients and the treatment of pulp are known as stock preparation. The stock is prepared in beaters, which consist of large tubs in which the pulp is crushed in great quantities of water by the action of rollers against a metal or stone bedplate. This beating serves to fray the ends of the individual fibers so that they will cling together. It also softens the cellulose of the fibers to cement the fibers into a solid mass. Beating is the most important step in papermaking, as the type and degree of beating determine the final character of the paper. Both blotting paper and bond paper may be made from the same pulp, depending upon the beating.

Refiners are also used to treat pulp in a manner similar to beating. Pulp refiners are large conical shells in which close-fitting, rotating plugs pulverize the fibers. These refiners are used with beaters to prepare pulp, or they can be used instead of the beaters.

Additives

Most of the papers made today require the addition of substances to the fibers to produce different papers for various purposes. These additives are grouped as follows: sizing, loaders and fillers, colorings, and special additives.

Substances added to paper to resist rapid, excessive moisture penetration are called sizing. Rosin sizing is the most widely used. If it is added in the beater, it is called engine or beater sizing. If the web of paper is passed through a tub of sizing, the sizing is called tub or surface sizing. Many printing papers, particularly offset papers, have been both beater sized and surface sized. An example of unsized paper is blotting, which readily absorbs liquids. Weak-sized papers are typified by newsprint. It will accept writing ink, but the ink will spread or "feather." Bond paper is an example of hard-sized paper. It will accept writing ink without feathering.

Various mineral substances are added to pulp to give it certain characteristics. These are known as loaders and fillers. Clay, calcium carbonate, talc, and titanium dioxide are used as fillers to even the paper surface and as loaders to increase opacity of the paper. Fillers and loaders may comprise 8 to 15 percent of the weight of offset papers.

Coloring materials, such as mineral pigments and organic and synthetic dyes, are used to produce a rainbow of colors in modern papers. Most pigments are added in the beaters; dyes are applied to the surface of the paper after it has been formed and sized in the papermaking machine.

Special additives are used for many different purposes. Bleaches are added to pulp to increase brightness. Vegetable starches are added as binders to smooth the surface and increase hardness. Resins may be added, or the fibers may be treated with dilute sulfuric acid to increase the wet strength of map and chart papers.

Coating

Uncoated paper consists of the paper stock just as it comes from the papermaking machine; coated stock is paper that has received a fine layer of mineral substances or a synthetic, plasticlike covering. Coatings may consist of clays, barium sulfate, calcium carbonate, and titanium dioxide in various combinations. They are applied by passing the web through vats or by using rollers or blades (similar to the ink fountain blade of your offset press). The coating may be applied to both sides of the paper, as in the case of paper used for quality pictorial magazines, or to only one side of the paper, as in the case of paper used for labels. Coated paper presents the smoothest surface possible for printing fine-quality halftones. The surface may be highly polished, or it may be matte or semimatte. Some paper manufacturers refer to their coated papers as "enameled" stocks, but this term has no precise technical meaning.

Finishing

The term *finish* or *finishing* refers to the last papermaking operation. This operation affects the appearance and the texture or feel of the paper. Since a smooth surface is important in fine halftone reproduction, most full-color printing is done on coated paper that has been finished to a high polish. The smoothing is done after the web has passed through the drying drums in the papermaking machine.

Antique paper is an example of paper stock that is used just as it comes from the papermaking machine. For a smoother surface, the paper is passed through a series of calender rollers on the papermaking machine. This stock is known as machine finish (MF) paper. It is possible to produce an even smoother surface by passing the paper through supercalenders one or more times. This paper is known as supercalendered (SC) or "super" and is one of the more frequently used printing surfaces. The calendering and supercalendering operations take place in a series of highly polished steel rollers, sometimes alternated with cotton or paper rollers, arranged in a stack. The paper is fed in at the top and is progressively compacted and smoothed as it passes down the stack. Coated papers are also passed through the supercalender stack to smooth and polish the coating.

Special finishes are applied to the paper in a number of ways. Papers used for better stationery are often given a laid or wove finish. These patterns are impressed into the wet web on the paper machine by a dandy roll. Evenly spaced wires across the roll produce the ladder or laid effect, while a woven screen of wires produces the wove finish. The dandy roll is also used to produce watermarks on paper, such as the familiar eagle and stars on U.S. government rag bond papers. After the paper web has been dried, other finishes, such as leather, pebble-grain, and linen may be produced by passing it through a rotary embossing machine.

PAPER GRAIN AND FACE

The grain of paper refers to the position of the fibers (fig. 15-1). The diluted pulp is flowed onto a screen in the papermaking machine. As the screen moves forward, it is agitated, and the fibers aline in a direction parallel to the length of the machine and the paper.

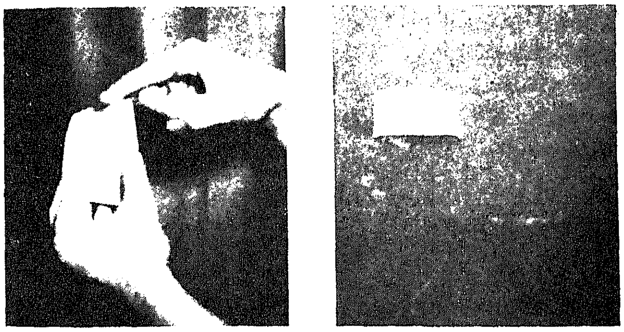


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Figure 15-1.—Paper grain can be determined by creasing paper in both directions and running your finger along both creases to see which edge is rougher (left). The smoother edge indicates the grain direction. Another method is to wet a 2″ by 2″ strip of paper and observe its curl (right). The strip will curl across the grain.

Paper grain is of particular importance to you, a Lithographer. First, paper is stiffer in the grain direction. This is important in the case of books and pamphlets, which are to be folded. The grain direction of the paper stock should be parallel to the binding edge; if it is not, the pages may be difficult to turn. Second, paper changes due to humidity (stretch or shrinkage) are greater across the grain than with it. To minimize the register problems on your offset press that are due to moisture, you should cut the paper so that the grain runs across the cylinder. Third, paper is more easily torn in the grain direction than against it.

Except for a few special papers, all papers have two distinct sides or "faces." The paper pulp is formed on a moving wire screen in the papermaking machine. The surface in contact with this screen is impressed with the pattern of the wire and is called the "wire side" or bottom of the sheet. The other surface is pressed against a series of felt rollers and is known as the "felt side" or top of the sheet. In the papermaking machine, there is a tendency for finer fibers and filler materials to float on the surface of the diluted pulp. Therefore, the felt side of the paper is a better printing surface, and the printing should be done on this side if you have a choice. Many fine commercial papers are marked or tagged to show the felt side. In the case of watermarked papers, the watermark reads properly (left to right) when viewed from the felt side. On U.S. government watermarked papers, the eagle faces to the left when you view a sheet from the felt side.

Although calendering removes most of the wire marks, you can determine the faces of an uncoated sheet by observing the surface with the light striking it at a 45-degree angle. The typical screen pattern may then be seen. Sometimes it may be necessary to dampen the sheet on both sides to swell the fibers, making the pattern more discernible.

BASIC SIZE AND BASIS WEIGHT

Size and weight in relation to printing papers are the basis of much confusion. Paper is identified by size (8 1/2 inches by 11 inches on a job order, for instance), but when bought from the mill, it is identified by weight (cost being determined by weight more than other factors). For you to make calculations regarding paper, two kinds of data are necessary. You must know the *basic size* and *basis weight.*

Basic size refers to the established standard size for a stock sheet of a specific type of paper. The basic sizes are related to the uses of the different papers and the presses on which the different products are printed. For instance, the basic size for business papers, such as bond and other types of writing paper, is 17 inches by 22 inches. As you know, most commercial stationery is 8 1/2 inches by 11 inches, and this can be cut four-out of a 17- by 22-inch sheet. Therefore, 17 inches by 22 inches is used as the basic size for all business papers. Publications work is generally run on 38-inch presses, so 25 inches by 38 inches is the accepted basic size for book papers. Basic sizes for various papers are given in figure 15-2.

Basis weight is the second factor to consider in working with paper. It is the weight of a quantity of paper of the basic size. The quantity is generally a ream (500 sheets), but at the Government Printing Office (GPO) and in many commercial firms, the double ream, or 1,000 sheets, is used in determining basis weight. The quantity is sometimes listed after the basic size to avoid confusion in designations of paper. For example, the paper on which this book is printed would be listed as Paper, Offset Book, White, 100 pounds (basis 25 inches by 38 inches/M) or 50 pounds (basis 25 inches by 38 inches/500). Note that both designations apply to the same paper.

Kind of paper	Basic size (inches)	Area (square inches)
Business papers (bond, ledger, manifold, mimeo, writing, map)	17 x 22	374
Blotting	19 x 24	456
Cover	20 x 26	520
Bristols, postcard, tag and blanks	22 1/2 x 28 1/2	641 *
Index	25 1/2 x 30 1/2	778 *
Newsprint, tissues, wrapping	24 x 36	864
Book papers (including offset and coated)	25 x 38	950

*rounded to nearest whole number

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Figure 15-2.—Basic sizes of papers.

Equivalent Weight

Knowing which weights of book paper are comparable (or equivalent) to bond, cover, index, and so on, can be useful to you. If it becomes necessary to substitute papers, you will have to compute equivalent weight, using the following formula:

$$\frac{\text{basis weight} \times \text{new size}}{\text{basic size}} = \text{equivalent weight}$$

Determine, for example, the equivalent weight of a ream of 50-pound book paper, basis 25 inches by 38 inches/500, cut to 17 inches by 22 inches. Substituting numbers in the formula gives

$$\frac{50 \times 17 \times 22}{25 \times 38} = ?$$

Cancelling, you get

$$\frac{\overset{2}{50} \times 17 \times \overset{11}{22}}{\underset{1}{25} \times \underset{19}{38}} = \frac{2 \times 17 \times 11}{1 \times 19} = \frac{374}{19} \quad 19.6$$

Thus, a ream of 17- by 22-inch book paper weighs 19.6 pounds, although it is still called a 50-pound stock.

Type of Paper (Basic Sizes)	Equivalent Weight of Indicated Paper (500 sheets)				
	Business	Cover	Index	News	Book
Business (Bond, ledger, manifold, mimeo, writing) (17 x 22)	13	18	27	30	33
	16	22	33	37	41
	20	28	42	46	51
	24	33	50	56	61
	28	39	58	64	71
	32	45	67	74	81
	36	50	75	83	91
	40	56	83	93	102
Cover (20 x 26)	29	40	60	66	73
	36	50	75	82	91
	43	60	90	100	110
	47	65	97	108	119
	58	80	120	134	146
	65	90	135	149	164
	72	100	150	166	183
Index (25 1/2 x 30 1/2)	43	60	90	100	110
	53	74	110	122	135
	67	93	140	156	170
	82	114	170	189	208
Newsprint, tissue, wrapping (24 x 36)	13	18	27	30	33
	14	19	29	32	35
Book (including coated and offset) (25 x 38)	12	16	25	27	30
	16	22	33	36	40
	18	25	37	41	45
	20	27	41	45	50
	24	33	49	55	60
	28	38	57	64	70
	31	44	65	73	80
	35	49	74	82	90
	39	55	82	91	100
	47	66	98	109	120

Basis weights are shown in columns enclosed by vertical rules

*Tissues are determined on the basis of 480-sheet ream

57.659

Figure 15-3.—Equivalent weights.

Figure 15-2 lists the basic sizes of various types of paper. To compare the weight of one type of paper with that of another having a different basic size, you must use the same type of computation. For easy reference, you may use the information provided in figure 15-3 for this purpose. This information provides a comparison of standard paper sizes and weights. For example, 24-pound bond is the equivalent of 33-pound cover, 50-pound index, 56-pound news, or 61-pound book.

Bulk and Caliper

The bulk of a paper stock is a term relating to the thickness of the paper. It should not be confused with the basis weight. Papers are said to "bulk at 320 to the inch," for instance, indicating that a stack 320 sheets high would measure 1 inch. Bulk is a function of the papermaking machine. Some book papers, for example, are made in 60-pound basis weights and bulk at from 320 to 720 to the inch. The one that bulks at 320 to the inch is said to be *high bulk* paper, as opposed to that which bulks 720 to the inch.

Thickness of paper is called *caliper*. Caliper refers to the thickness of a single sheet of paper. Caliper is expressed in ten-thousandths of an inch (fig. 15-4). Knowledge of the caliper of the paper in your shop can be useful to you, particularly if you need to underpack the press plate or blanket on your offset press. Larger shops often have paper micrometers, but a machinist's micrometer may be used in determining paper caliper. The paper should be "miked" at several places on a sheet to obtain an average micrometer reading.

Cardboard was traditionally measured by the number of plies, or layers of paper, used in its manufacture, such as 4-ply, 8-ply, and 14-ply. Most of the cardboards today are measured in thousandths of an inch, the same as other papers.

TYPES OF PAPER

There are three divisions of paper stock used in the printing industry. They are (1) commercial and book papers, (2) packaging papers and boards or cardboards, and (3) newspapers. You will be most concerned with the first of these three kinds of paper. However, all three divisions may include one or more of the papers typical of the others.

Book Papers

Papers usually have a name that identifies the purpose for which they were originally made. Such is the case with book paper, the largest class of printing papers. Book papers are manufactured in a great variety of finishes, colors, and basis weights. Their basic size is 25 inches by 38 inches. Commonly used basis weights are shown in figure 15-4. Machine finish (MF) paper is the least expensive of the book papers. It is made from chemical wood pulp and contains little filler or sizing. Machine finish paper is suitable only for coarse-screen halftones and line work on a letterpress.

Antique is a frequently used, bulky paper. It is a soft, uncoated paper, which folds well, and is widely used for magazines and books consisting of text and line illustrations. Most antique papers are not sized for offset printing. Although you should not be working with either machine finish or antique papers, you should know what they are.

APPROXIMATE MICROMETER READINGS

Type of Paper	Basis Weight *	Caliper **
Bond, 25% rag	16	.0025
	20	.0033
Writing, Chemical Wood	16	.0032
	20	.0038
Ledger	24	.0042
	32	.0054
	44	.0072
Mimeo	20	.0050
Manifold, 25% rag and Chemical Wood	9	.0018
Map, 50% rag	24	.0030
Cover, Antique	50	.0070
Coated	60	.0060
Antique Laid	65	.0100
Index, Chemical Wood	110	.0085
	140	.0105
Newsprint	32	.0035
Book, English Finish	45	.0025
Antique, 50% rag	40	.0035
	45	.0038
	50	.0043
	60	.0050
Offset	40	.0027
	50	.0037
	60	.0042
	80	.0065
Offset, Opacified	60	.0045
Offset, Coated	50	.0025
	60	.0030
	70	.0033

* pounds per ream of 500 sheets
** inches

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Figure 15-4.—Paper caliper.

Supercalendered (SC) and sized and supercalendered (S&SC) papers are given a smoother surface during manufacture. This smoother surface is better for reproduction of fine halftones by letterpress than the surface of MF stock.

Some "supers" are sized for use in offset printing.

Offset book papers are those that have received special sizing to prevent rapid absorption of moisture during the press run. The term *offset book paper* is generally accepted to mean an uncoated, wove-finish paper. Offset papers may be run on letterpress equipment, but not all letterpress papers may be printed by the offset process. This is due to the lack of sizing in letterpress papers.

Coated papers are the "elite" of the book papers. The base paper stock is most often tub sized and then surface sized, dried, and supercalendered. The coatings are then applied to one or both sides, and the paper stock is then supercalendered again to provide a very smooth surface.

Coated papers may be finished to a high gloss, or they may have a matte or semimatte finish as required. Although all coated papers are sized, the soluble binders used with some coatings make them unsuitable for offset printing.

NOTE

It is not possible to list all the papers available on the commercial market. This chapter is intended to give you an idea of the principal types of paper stock and their uses.

Paper stowage and requisitioning methods may differ from ship to ship. However, you should keep two things in mind when requisitioning paper stock: the size limitation of your paper cutter and limitations imposed by stowage.

Business Papers

The broad classification "business papers" covers those papers that are used for stationery items and business forms, rather than for publications work or promotional or advertising printing. The basic size for all such papers is 17 inches by 22 inches.

The paper of this class that you will use most often is called bond. The name refers to its original purpose, that of printing legal documents such as bonds and stock certificates. Some bond papers are made from chemical wood pulp; the better grades contain rag fibers. All bond papers are sized to accept writing inks without feathering. Some bonds receive special coatings to make erasures easy. Business forms are usually printed on sulfite bond papers.

A heavier paper with similar characteristics is known as *ledger*. It was originally designed for the printing of accounting records. In addition to its long life and its ability to readily accept inks, ledger has an extremely good folding endurance, which means it may be folded repeatedly without cracking or tearing along the fold. Ledger also has a good erasure tolerance.

At the other end of the scale, lighter-than-bond papers are known as *manifold*. These lightweight papers are used for carbon copies. Rag-content manifold papers are often referred to as *onionskin* because of their texture. They are often used as airmail stationery.

A specially treated business paper is used for checks, receipts, and similar documents that must be protected against alteration. Such papers are called *safety papers*. They usually have watermarks consisting of geometric designs or similar protective markings.

Although not technically a business paper, there is another paper with a basic size of 17 inches by 22 inches. This is known as *map stock* or *wet-strength stock*. Map papers are used for charts and maps, which are subject to hard usage and exposure to the elements. They must accept inks with a minimum of penetration, must have good opacity, and must have good folding qualities. Made of bleached sulfite pulp, with up to 50% rag fiber content, the paper is hard sized, then treated with resins. These resins bind the fibers together with an almost insoluble bond. Special provisions must be made for destruction of classified matter printed on map stock, as it cannot be pulped.

Carbonless Papers

There are specially coated business papers that eliminate the necessity of using carbon paper in making duplicate copies. These papers are coated with certain chemicals that react under contact and pressure of a pen, pencil, or typewriter key to produce a duplicate image on successive sheets. As many as 15 legible copies may be made with an electric typewriter on some of these papers, but the normal quantity of copies is 8 or 9.

With carbonless papers, the image is transferred when chemicals from the back of one sheet combine with chemicals on the front of the next sheet. Top sheets (originals) are coated on the back only (CB), and the bottom sheets are

CFB is considered an all purpose stock and can be used, in most cases, where carbonless paper is required.

Carbonless papers are not compatible with one another, so they cannot be used interchangeably. Another word of caution: the system will not work if the printed image is on the wrong side. You must determine the proper side of the carbonless paper before printing. Generally, the coated side of carbonless paper has a gritty feel to it, while the uncoated side is smoother. A test may be made by placing two sheets together and marking the top. If the mark is transferred to the bottom sheet, the proper printing sides of the sheets are up.

Several points should be observed when you are working with carbonless papers that will help to eliminate many of the problems that can occur in your pressroom. Some of the problems can be prevented by allowing the paper to condition itself to the atmosphere of the pressroom area. This conditioning period permits the paper to adjust to the humidity and temperature of the pressroom gradually, thereby reducing the possibility of the sheets curling or wrinkling as they are run through the press. This is true of all papers, but is more important when the paper is carbonless.

The pressure (impression) setting between the blanket cylinder and the impression cylinder must be adjusted to a minimum to produce an even impression on the sheet without "toning" it. Additionally, you should check the sheets for pressure marks from the press forwarding rollers, caliper, sheet hold-downs, grippers, and ejector wheels.

When you are cutting carbonless papers, place scrap pieces of chipboard or index paper on the top and bottom of the paper lift to eliminate pressure marks from the paper clamp. Also use minimum clamp pressure as you operate the paper cutter.

Bristols and Cardboards

Bristols are lightweight cardboards; there are three types: (1) index, (2) mill bristol, and (3) wedding bristol. Index is a heavyweight writing paper, sized to accept writing inks and permit easy erasure. The basic size of index is 25 1/2 inches by 30 1/2 inches. Mill bristols are manufactured for use as advertising materials, such as Navy recruiting window cards, which require a stiff sheet with a good printing surface. Wedding bristol is manufactured of plies of white boards,

respondence. The basic size for mill and wedding bristols is 22 1/2 inches by 28 1/2 inches.

Another card stock you should be familiar with is called postcard. Postcard stock is manufactured in two types—coated and uncoated. The coated postcard is coated on one side, for the printing of such items as souvenir postcards, and the other side is sized to accept writing inks. Uncoated postcard is similar to mill bristol, but has been sized to accept writing inks on both sides. The most common example is the postal card. Basic size for postcard stock is 22 1/2 inches by 28 1/2 inches.

Tagboard is another lightweight cardboard, most often made of sulfate pulp and hard sized and supercalendered. It is an especially tough board, made for rough use such as baggage tags. The basic size for all tagboard is 22 1/2 inches by 28 1/2 inches.

There are instances where exceptionally hard use will be given to a publication—a telephone book, for instance. In this case, it may be advisable to use an index or tagboard cover.

Covers

Using a strong, serviceable cover on a publication prolongs its useful life. A broad range of cover papers is available. They come in a great variety of colors, bold or pastel, with embossed or plain finishes, are coated or uncoated, gloss or matte, and some even have one color on the front and a different color on the back.

Cover papers may be used for purposes other than book covers. Programs and menus are two applications for which cover papers are especially suited. You will find that printing with a darker ink of the same color as a pastel cover produces an interesting effect, and a dark, complementary color printed on a pastel cover stock will give a pleasing two-color effect. The basic size for all cover papers is 20 inches by 26 inches.

Miscellaneous Papers

Newsprint is used in enormous quantities by daily and weekly newspapers. It requires characteristics not needed by other classes of paper. It must also be as inexpensive as possible, because it need not be kept permanently, and it must have the ability to absorb ink readily as it passes through high-speed presses.

To be inexpensive, newsprint must be made of ground wood pulp. Since newsprint does not need permanence ("Nothing is as old as yesterday's news," goes the saying), pulp is very lightly beaten. The inks used in newspaper printing are fluid and dry by absorption, so the pulp contains little or no sizing. It is possible to produce colored newsprint by adding pigments to the pulp. This paper is known as poster stock. The basic size for newsprint is 24 inches by 36 inches. Almost all newsprint is made in basis weight of 32 pounds, although it can be obtained in weights from 30 to 35 pounds (basis 24 inches by 36 inches/500).

Blotting papers are not used as frequently as they once were, as we do most of our writing with ball-point pens. Blottings are loosely beaten, unsized, soft-finished papers with a natural affinity for water. Some blotting papers are coated on one side for use as advertising pieces. The basic size is 19 inches by 24 inches, and basis weights range from 80 pounds to 240 pounds (basis 19 inches by 24 inches/500).

The packaging industry uses a variety of papers and boards. For example, label paper is one type that is used. Many label papers are coated on one side to provide a smooth printing surface and are unfinished on the other to provide a good "tooth" for glues and cements used in packaging. Special sizing is used to prevent the adhesive from soaking into the paper. The basic size for label papers is 20 inches by 25 inches.

Heavyweight boards are called mill blanks, coated blanks, and railroad board. All are made by pasting layers of finished stock to a base stock similar to chipboard. Blanks are made in thicknesses from 0.012 inch to 0.078 inch (12 to 78 points) and are used primarily in the packaging industry. You may have need for heavy-duty signs and be asked to print on blanks. A word of caution: Presses using cylinders (all offset presses, and flatbed letterpresses) are not suitable for printing stock heavier than 0.030 inch (sometimes called 8-ply). A platen press is the only means of printing on these heavier stocks. The basic size for blanks is 22 1/2 inches by 28 1/2 inches.

Tissue is a thin, lightweight paper. The term is most often used to describe light wrapping papers, as distinguished from facial and other soft tissue papers. Most tissue papers are made of chemical wood pulp and are sized and machine finished. The basic size of tissue papers is 24 inches by 36 inches, and tissues range in weight from 12 to 18 pounds, but basis weights are determined with a 480-sheet ream. This is because tissues are traditionally sold at retail in quires (24 sheets). Tissues form the base for many carbon papers. These are usually rag-content tissue papers, specially sized and glazed.

Wrapping paper is another group of miscellaneous paper that you may use. The most commonly used wrapping paper is that made of strong sulfite pulp. This wrapping paper is usually brown in color and is sold in rolls for use in wrapping packages.

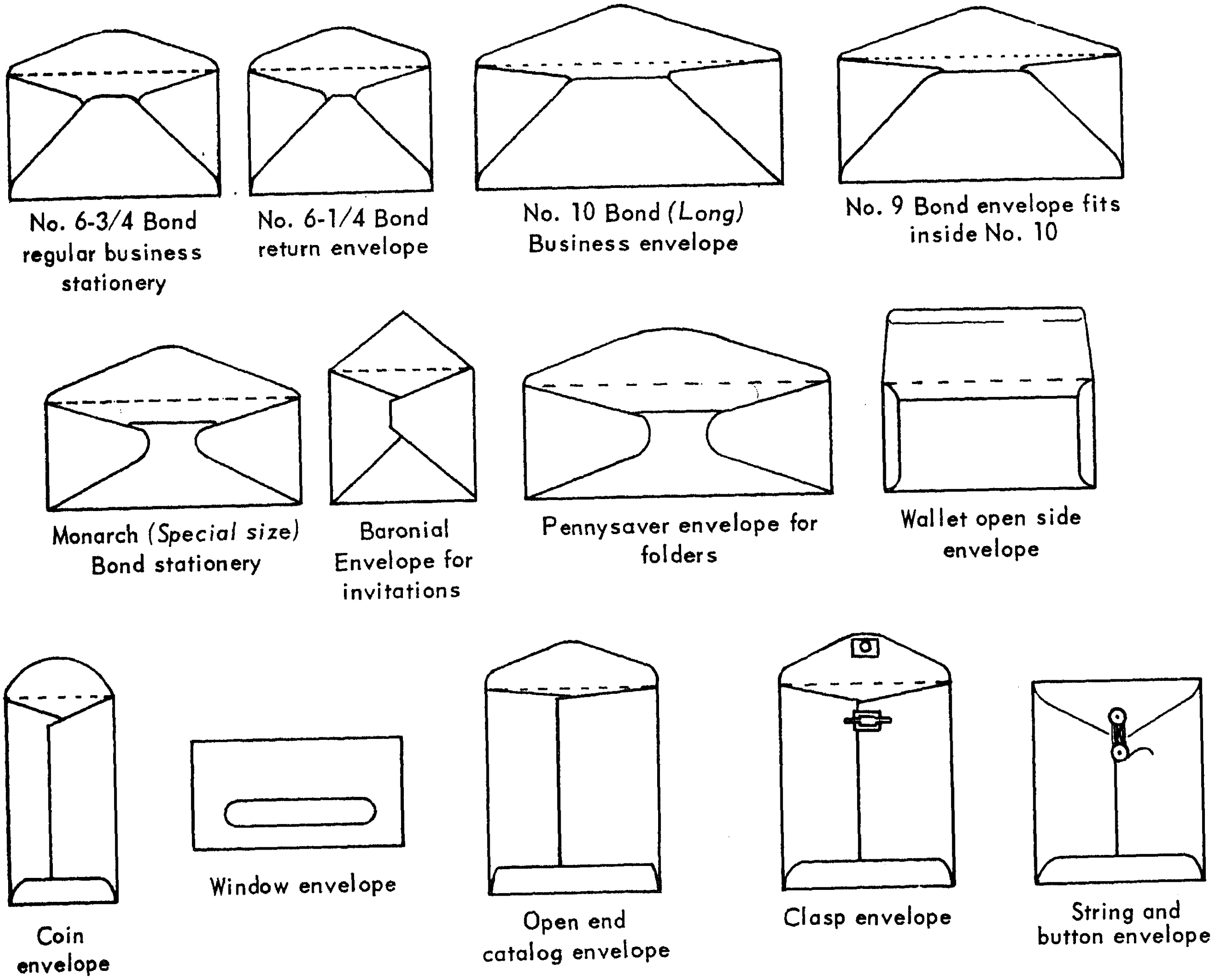
Although brown wrapping paper is made in basis weights of from 18 to 250 pounds (24 inches by 36 inches/500), it is generally used in weights of 25 to 80 pounds. In addition to the common brown wrapping paper, other wrapping papers, such as decorative or gift wrappings, are manufactured. The basic size for all wrappings is 24 inches by 36 inches. A special type of sulfate wrapping, sometimes containing jute-fiber pulp, is used as a draw sheet (tympan) on platen or cylinder letterpresses. This paper is made of well beaten pulp, is hard sized, and is calendered to a precision caliper. Tympan paper is manufactured in thicknesses ranging from 0.003 inch to 0.012 inch, with 0.006 inch most generally used. It is sold in rolls or is custom-cut for specific presses. Some tympan papers are oil-treated.

RECYCLED PAPER

There should be an emphasis in ecology and man's efficient use of raw materials in products. The papermaking and printing industries, in cooperation with government agencies, have spent considerable time and money researching the more efficient use of raw materials.

The use of waste materials in the manufacture of papers is not new. As you have seen earlier in this chapter, old paper and rags are processed to obtain the pulp that is used in the papermaking process. This practice helps to conserve natural raw materials.

The two most obvious advantages of using waste materials in the papermaking process are a reduction in the amount of timber required and a lesser amount of waste for disposal. Problems associated with recycled paper usage are increased production costs by the paper mill and a reluctance by the printing trade and its customers to use a product thought by many to be inferior to "new" paper.


No. 6-3/4 Bond regular business stationery
No. 6-1/4 Bond return envelope
No. 10 Bond (Long) Business envelope
No. 9 Bond envelope fits inside No. 10
Monarch (Special size) Bond stationery
Baronial Envelope for invitations
Pennysaver envelope for folders
Wallet open side envelope
Coin envelope
Window envelope
Open end catalog envelope
Clasp envelope
String and button envelope

COMMERCIAL ENVELOPES

NUMBER	SIZE *(inches)*
6-1/4	3-1/2 x 6
6-3/4	3-5/8 x 6-1/2
9	3-7/8 x 8-7/8
10	4-1/8 x 9-1/2
Monarch *(for 7-1/4 x 10-1/2 inch social stationery)*	3-7/8 x 7-1/2

BARONIAL *(announcement)* **ENVELOPES**

NUMBER	SIZE *(inches)*	CARD SIZE
4	3-5/8 x 4-11/16	3-1/2 x 4-9/16
5	4-1/8 x 5-1/8	4 x 5
5-1/2	4-3/8 x 5-5/8	4-1/4 x 5-1/2
6	5 x 6	4-3/4 x 5-3/4

KRAFT AND MANILA ENVELOPES are designated by size and opening, with indications as to gumming. An envelope with an end opening (OE) are sometimes referred to as catalog envelopes; a side opening (OS) envelope is also known as a booklet envelope. Commonly used sizes of open end *(gummed)* envelopes range from 2-1/4" x 3-1/2" to 3-3/4" x 5-7/8"; and *(gummed)* open side envelopes range from 3-7/8" x 7-1/2" to to 14-1/2" x 18".

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Figure 15-5.—Envelopes.

Tests have shown that the printability of recycled paper is superior in many ways to paper that does not contain recycled materials. The fibers in recycled paper tend to allow the sheets to lie flatter and to increase the paper's opacity.

ENVELOPES

An envelope is essentially a container. Its purpose is to protect its contents during transit or storage. Envelopes are made in a variety of sizes and shapes, and with papers of almost every conceivable type.

Most envelopes are made of rag-content stock. The cheaper grades are made of sulfite or sulfate papers. When used for general mailing, they are usually made with a wove finish. They may be made of lightweight cover papers when used for advertising mail, and are made of lightweight rag and sulfate stock when used for airmail.

When you need an envelope for heavier usage, they are made of heavier brown papers and manila sulfate stocks. Still stronger envelopes are made of lightweight tagboard or ledger papers. Illustrations of commonly used envelopes and their sizes are shown in figure 15-5.

Printing of large quantities of envelopes is often done in the course of manufacture. You may be required, however, to print envelopes in your shop on offset presses. Because of the varying layers of paper in envelopes, special press makeready is often necessary.

CARING FOR PAPER

Paper is composed of fibers that are easily affected by moisture. Because of this, paper is dimensionally unstable. A sheet of paper will soak up moisture and expand in a moist atmosphere, or it will lose moisture and shrink in a dry atmosphere. When paper is piled (stacked), the changes affect the edges of the sheets first, and it is there that the changes are most noticeable. Dry paper, in a humid area, absorbs moisture along the exposed edges, expands, and develops wavy edges, particularly across the grain. Paper that has a high moisture content, when left in a dry atmosphere, loses moisture, shrinks, and develops tight edges. These changes are also more severe across the grain. This is because the paper fibers expand and contract more readily in their diameter than in their length. Figure 15-6 shows these various conditions.

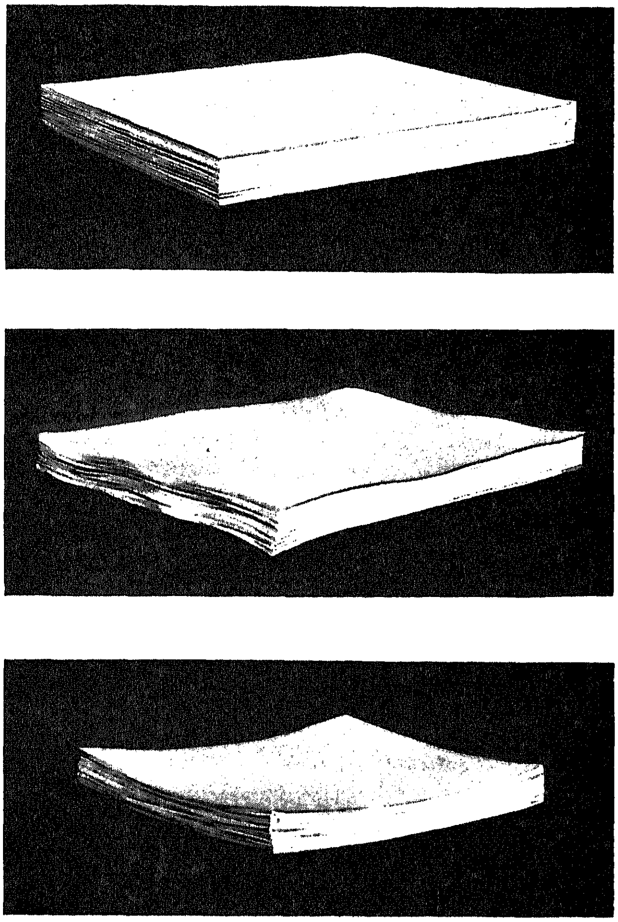

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Figure 15-6.—Flat paper, wavy-edged paper, and tight-edged paper.

Whether the problem is a wavy edge or a tight edge, paper that has been altered by moisture is no longer flat. When such a sheet is subjected to the continuous, equalized squeeze of offset printing, distortion, misregister, and wrinkling are likely to occur.

When paper is brought into the pressroom from storage areas, it should remain in its sealed wrappers until it has reached stability with the shop atmosphere. This is particularly important when the difference in atmosphere is pronounced, such as would be the case if the paper were just brought up from a storeroom below the waterline to a warm shop above the main deck. The ideal condition for the paper for offset printing is to have a moisture content at or slightly above that of the pressroom. Allowing the paper to remain in its sealed packages until moisture balance is reached is called seasoning, or conditioning. Seasoning is the most effective preventive for paper problems.

You know that moisture changes to the paper are less pronounced with the grain than across it. For this reason, paper is usually cut so that the grain runs across the press cylinders rather than around them. In most cases, this means that the paper is cut long grain. On small duplicator offset presses, however, short grain paper is better. This may result in an uneconomical cut from mill sheets of paper, but the circumstances may warrant this practice.

Changes in paper sheet size caused by moisture on the press are most often unimportant. However, in the case of multiple press runs using the same press sheet (charts for an amphibious landing, for example), dimensional changes can present serious register problems. Too often, the misregister is not noticed until the second or subsequent press run. It is then too late to remedy the problem without running the first image again on fresh stock. Reduced packing under the plate and increased blanket packing may compensate for paper stretch, while a reversal of this procedure may compensate for shrinkage of the press sheet. Reducing the blanket packing along the side edges may be helpful when running wavy-edged paper. Minimum impression-cylinder pressure may also help.

Excess press moisture sometimes creates a problem when you are running large solids on lightweight papers. Moisture on the upper surface of the paper will cause swelling of the fibers, resulting in a downward curl of the press sheet. As the moisture is absorbed or evaporated, it causes shrinkage of the upper surface, this time resulting in an upward curl. Running the press with a minimum of moisture is especially important in these cases.

STATIC

Rubbing two unlike surfaces together generates static electricity. Running your comb through your hair will create such a charge, and you may have noticed how small pieces of paper will cling to the comb. A similar condition exists when paper passes through the press. If the proper humidity balance has been attained, the moisture in the paper will act as a ground and will dissipate the static charge. If the moisture content of the paper is low (and this is often the case in cold weather), static may cause the paper to cling to the blanket or impression cylinder of the press. Sheets charged with static electricity may also cling together, causing the ink to offset.

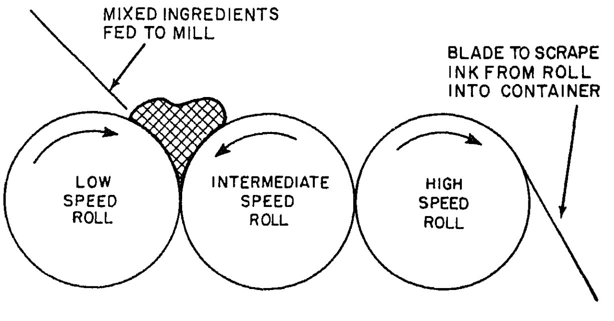

MIXED INGREDIENTS FED TO MILL
BLADE TO SCRAPE INK FROM ROLL INTO CONTAINER
LOW SPEED ROLL
INTERMEDIATE SPEED ROLL
HIGH SPEED ROLL
57.661

Figure 15-7.—Schematic diagram of a three-roller ink mill. As the rollers turn, the pigment is evenly dispersed in the vehicle. The particles of pigment must be small enough to permit even coverage by the vehicle. The ink cannot have a gritty consistency, or damage to the plates could result.

Static eliminators are attached to many larger presses, and tinsel is often used on duplicator-type offset presses to remove the static electricity. The most effective means of static control is proper moisture balance.

INK

All printing inks consist of pigments or coloring matter, vehicles that carry the pigment, and additives that modify the other two ingredients. These ingredients are blended together in varying amounts to produce the many types of ink required for the modern printing industry. The ingredients are first mixed, then milled in an ink mill (fig. 15-7). The ink is then packaged in drums or in the familiar 1- and 5-pound cans or in tubes or cartridges.

PIGMENTS

The coloring matter of ink is provided by a substance known as pigment. There are two broad classifications of pigments: inorganic or mineral pigments (mostly metallic), and organic or synthetic pigments (mostly derived from petroleum or coal tars). In addition to providing color, pigments impart other characteristics to the ink, such as opacity or transparency, lightfastness, and weather resistance.

Black is the most common pigment color. The most common of these is carbon black, which is made by partial combustion of natural gas. Other black pigments are made by burning oils (called lamp black), grape husks and vines (called vegetable black), and animal bones (called bone or ivory black). Pigment made of black iron oxide is used for the printing of bank checks, which are processed electronically. The iron particles are magnetized during the processing. Most black pigments have a blue undertone, but certain vegetable blacks have a red undertone. The term *undertone* and its companion *masstone* are discussed later in this chapter.

White pigments also have wide usage. The most common of these is titanium dioxide. It is made from a natural ore, ilmenite, which is, ironically, jet black. Transparent white pigments are sometimes called extenders. Among the most common are alumina hydrate, blanc fixe, and gloss white. Gloss white is a chemical combination of the other two. White pigments serve to reduce highly concentrated organic pigments and improve their working qualities. Alumina hydrate, when used alone, has a tendency to cause livering, which is discussed later in this chapter.

The rainbow of colors used in printing inks is produced by a variety of pigments, ranging from simple mineral salts to complex synthetics. Some are relatively opaque, while others are almost transparent.

VEHICLES

The vehicle of ink must be fluid on the press rollers and must dry almost instantly when transferred to the press sheet paper. This vehicle must hold the pigment and it must adhere to the paper or other stock. The vehicle also provides the gloss or other finish of the printed page, and it influences the wearing qualities of the printed image. In addition to flowing properly on the press, the vehicle must protect the pigment from the action of the acids in the fountain solution.

Lithographic varnish is the most commonly used vehicle. It is composed largely of boiled linseed oil. Linseed oil is derived from flax seeds. After being purified, the oil is "cooked" under pressure at varying temperatures and for varying lengths of time, depending on the consistency desired. Varnish viscosity is indicated by numbers ranging from 00000 to 9. Varnish No. 00000 is the least viscous, being just a little thicker than water, while No. 9 is the heaviest, being similar in viscosity to shortening or lard. The varnishes numbered 00000 to 0 tend to thin the ink, and those numbered 1 to 9 tend to thicken it. The two heaviest varnishes, Nos. 8 and 9, are sometimes referred to as body gum.

In addition to being derived from flax seeds, vehicles for printing inks may be made of other vegetable oils, such as tung (also called China wood oil) and soybean. Some types of fish oils are also used to make varnishes.

Sometimes vehicles are made of combinations of oils and resins. Either the oil or the resin or both may be natural or synthetic. The heat-set inks are an example of resinous-vehicle inks. Mineral oils are sometimes used as the vehicles for newspaper inks, and other specialized vehicles are used in other phases of the printing industry.

ADDITIVES

Substances used to modify the vehicle or pigments are called *additives* and are used in very small proportions. Included in this group are materials such as metallic driers, waxes, anti-skinning agents, retarders, and even perfumes.

The most important of the additives are the driers. Driers are metallic compounds that act as catalysts. That is, they promote or accelerate the natural drying of the vehicle without being changed themselves. Metals such as cobalt, lead, and manganese are the most commonly used. Cobalt (or liquid) driers are the most effective, but they have limitations. They dry from the top surface of the ink down to the paper surface. It forms a film that will not trap or accept successive inks in multicolor work. Lead or maganese is used in combination with cobalt in paste driers, where drying from the paper up is required.

Driers are added to inks in small amounts, a little at a time. The rule of thumb is 1 ounce to 1 pound, but up to one and one-half ounces may be added if required. Larger quantities of drier do not cause faster drying. They may even retard it. This is especially true in the case of liquid driers. Less drier should be used in colored inks than in black.

Waxes of various types are sometimes added to provide a special surface to the dried ink. Anti-skinning agents and retarders are used to prevent drying of the ink in the ink fountain or on the press rollers of your offset press. Perfumes are used to cover odors in the ink, which might be objectionable, or to give a scent to inks compounded for advertising materials.

PROPERTIES OF INKS

The physical properties of inks are almost entirely those of the vehicle. As you have seen, lithographic varnishes are linseed oils that have been cooked until they have reached the proper consistency. Those cooked for a short period are light and syrupy; those that have been cooked longer and at higher temperatures are heavier.

Body

The property of ink relative to its consistency is known as body. An ink with a heavy body is called short or stiff. Its consistency is much like shortening or heavy grease. A small amount placed between the thumb and forefinger will break readily when the fingers are separated. As the body of the ink becomes thinner, it becomes long or soft. Its consistency is like molasses or motor oil. Most ink is of the proper consistency just as it comes from the container. The ink should not, however, be taken directly from the can and placed in the ink fountain. Most lithographic inks are thixotropic; that is, their consistency changes depending upon their state. When in the container, they are rather short, but as they are stirred, they become longer. Before adding varnishes to thin an ink, you should work it out on an ink stone, a piece of glass, or the back of an old metal offset press plate. Using an old plate allows you to dispose of the plate after mixing the ink, instead of having to clean it. If the body of the ink needs alteration, you should only add small quantities of varnish. Keep a record of the amount you add so that you can duplicate the ink mixture again if necessary.

Tack

Tack is related to the body of the ink. It refers to its stickiness, or the force required to split an ink film between two surfaces. Tack is necessary to transfer the ink from roller to roller, to the plate, to the blanket, and to the press sheet. Tack is also necessary to ensure that the ink adheres only to the image areas and does not flow to non-image areas of the plate. There must be a sharp break between these two areas. Tack is also important in multicolor work and all jobs requiring more than one press run, where trapping of successive colors and other images is required. Tack must be carefully adjusted, with the first-down ink being tackiest and successive inks progressively less tacky.

Conversely, excessive tack is also a serious ink problem. The most common symptom of excess tack is "picking" of the paper, in which the ink tears off particles of the paper surface.

Drying of Inks

The drying of printing inks occurs when the ink changes from a fluid state to a solid state. It occurs in two stages: "setting," when the sheets can be handled without smearing, and "hardening," when final drying has taken place. Ink that has set or set up properly can be handled without damage in successive printshop operations.

Drying of ink involves chemical and physical actions, depending on the vehicle used. The first type of drying action is oxidation, in which the vehicle absorbs oxygen from the air. The oxygen changes the molecular structure of the oils in the varnish and they become solidified. The second drying action is known as polymerization, in which smaller molecules of the vehicle combine into larger, more complex molecules. Most lithographic inks dry by a combination of oxidation and polymerization, in which the vehicle has solidified and formed a bond between the pigment and the press sheet.

The third drying action is penetration. All inks used on absorbent materials have some penetration, but there is only one ink that dries exclusively by penetration. This type is known as news ink, because it is used for the relief printing of newspapers. The vehicle of this ink is mineral oil, and it does not dry completely. This is the reason your hands may get dirty when you are reading the daily newspaper. As the vehicle is absorbed by the paper, the pigment is deposited on the surface, where it can be readily rubbed off.

There are several other drying methods that you should know. Inks that contain resins in solvents dry by evaporation. The solvents evaporate, leaving a dry resin film on the paper stock. Examples of this type of drying are rotogravure and flexographic inks. Most of these inks require heat to accelerate evaporation. Some special-purpose inks dry by gelation, in which the resins from the vehicle form a film similar to gelatin on the surface of the paper stock. Drying may also occur as the ink cools. This happens when the ink is applied to the press sheet in a molten state by heated rollers. Then the press sheet passes over chilled rollers to set and dry the ink.

MIXING OF INKS

Printing by offset lithography requires that you place a very thin film of ink on the finished page. For this reason, it is best for you to use inks that are as concentrated and unreduced as possible. Most offset inks manufactured today are ready to use straight from their containers after you have worked them out. You should refer to figure 15-8 if special conditions require the addition of driers, thinners, and so on. After the ink container is opened, the cover sheet (usually oiled paper) should be completely removed. If a crust or skin has formed on the ink, it, too, should be completely removed and discarded. (If you use cartridge-type inks, the first one-fourth inch of the ink from the spout should be discarded.)

Additive	Reduces color depth	Reduces color strength	Softens (lengthens) ink	Stiffens (shortens) ink	Adds gloss	Decreases gloss	Speeds drying	Slows drying	Increases tack	Decreases tack
	Properties									
Alumina hydrate *	x	x			x				x	
Blanc fixe	x	x							x	
Castor oil	x	x	x					x		x
Covering (gloss) white	x	x			x					
Kerosene	x	x	x			x		x		x
Liquid (cobalt) driers	x	x	x		x		x			x
Linseed oil (raw)	x	x	x							
Linseed oil (boiled)	x	x	x			x				x
Magnesia powder	x	x		x		x			x	
Mineral oil	x	x						x		x
Mixing white	x	x								
Lard oil	x	x	x			x		x		x
Oleic acid	x	x	x					x		x
Palm oil	x	x	x					x		x
Paraffin oil	x	x	x			x		x		x
Paste (manganese/lead) driers	x	x			x		x			
Tallow	x	x				x		x		x
Varnishes:										
00000 (very light)	x	x	x			x				x
0000	x	x	x			x				x
000	x	x	x			x				x
00 (light)	x	x	x			x				x
0	x	x	x							x
1	x	x	x							
3 (medium)	x	x								
5	x	x		x	x			x		
7 (heavy)	x	x		x	x			x		
8 (body gum)	x	x		x	x			x		
9 (body gum)	x	x		x	x			x		
Vaseline	x	x	x			x		x		x
Waxes	x	x	x							x
Wool grease	x	x				x		x		x

*alumina hydrate tends toward livering of ink

57.571

Figure 15-8.—Ink additives.

Then, with the blade of the ink knife, you may remove the desired quantity of ink and place it on the mixing stone. Do not gouge out chunks of ink; instead, skim off an even layer of ink with a circular motion of the blade of your ink knife. Then, the ink should be worked out with an ink knife or spatula. Larger shops have ink stones at each press or even a room where the ink is worked out or mixed. Small shops use old metal offset plates or sheets of glass for working out or mixing their ink. You should draw the knife or spatula through the ink, spreading it in an even film on the stone. Work the ink in one direction, then work it at a right angle to that direction. Bring the ink from the edges into the center and work it out again to the sides. After the ink is worked to its proper consistency, you can work small quantities of the required additives into it, until the proper formulation is reached. Additives should be added gradually and be thoroughly worked in, even though considerable quantities are required, as might be the case in duplicating a previous ink order for a large job.

After you remove the required ink from the can, the remaining ink should be protected. For long-term storage, you should use a small disk of oiled paper placed firmly against the ink surface, then work out all air bubbles from underneath the oiled paper. In the case of inks that are used frequently, some shops use a thin layer of water in the ink container to prevent air from reaching the ink surface. The water is poured off before the ink in the can is again used. You should not use a layer of oil to prevent skinning, as the oil may have an adverse effect on the vehicle of the ink. If your shop uses cartridge-type inks, always replace the cap on the spout—after releasing the pressure on the ram of the ink gun.

COLOR

Almost all the work that you will run will be printed in black ink. There may be jobs that will require color, although the use of more than one color of ink on a job is prohibited in government printing except where the addition of color is of functional value. Examples of work that may require color are hydrographic charts or recognition charts of flags and pennants. For this reason, you are required to know the principles of color and the mixing of colored inks.

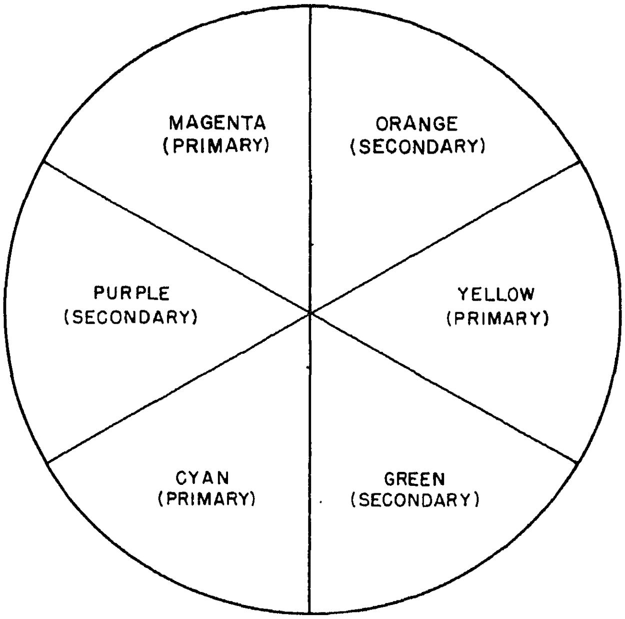
What is Color?

White light is composed of a series of light rays of varying length, of which violet rays are shortest and red rays longest, with blue, green, yellow and orange of intermediate lengths. The colors of red, green, and blue are known as the primary colors of light. If mixed in equal proportions, they produce white light. If beams of red and green light are overlapped, yellow is produced; green and blue beams produce cyan; and a mixture of red and blue light produces magenta. This mixing of colors of light by overlapping light beams is known as additive color.

Subtractive Color

In dealing with printing inks, you face the opposite side of the color picture. You are not dealing with light beams transmitted through various filters, but with the light that is reflected from the surface of an object. An object that appears red in daylight is red because its surface absorbs the green and blue portions of the white light and reflects the red portion of the spectrum. If a red light were directed toward the object, it would still appear red; but if a blue or green light were focused on it, the object would appear black, because the blue or green light would contain no red to be reflected from the surface. This phenomenon of selective absorption and reflection is known as subtractive color, and occurs when inks, dyes, and so on are mixed. Each of the materials has its own range of selective absorption; the final mixture has a combination of the absorption of all its components. As a result of this, the mixture always reflects less light than its components, or in other words, it always subtracts some of the light reflected.

The primary subtractive colors are yellow, cyan, and magenta. Note that these are the colors resulting from a combination of the three primary additive colors. Cyan and magenta are often improperly called process blue and process red, respectively. Mixing equal portions of yellow and cyan produces green; cyan and magenta produce purple; and magenta and yellow produce orange. These mixtures are called secondary colors. If you will refer to figure 15-9, you will see that the primary colors are located equidistant around the color wheel, and the secondary colors are located between their component colors. Directly across from each color is its complementary color. As you can see, the complement of magenta is green, a mixture of cyan and yellow. The complement of purple (a mixture of cyan and magenta) is yellow. Mixing a color and its complement produces a grayed color, usually undesirable. As you can see, white reflects all colors, whereas



57.446

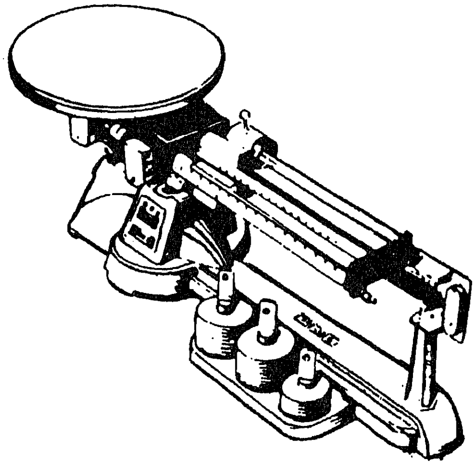
Figure 15-9.—Subtractive color wheel.

black absorbs all colors and reflects none, so it is, technically, not a color.

Mixing Inks for Colors

You will seldom use the pure primary or secondary colors. Often the job originator will only specify that you use a *deep red* or *light green* for the job. In these cases you can use the color of ink that is on hand straight from the manufacturer's container. You may, however, be required to match a color that has been specified by the originator of the printing job. Since it is practically impossible to stock all the colors of inks available, ink manufacturers have devised a universally accepted system for matching the various color blends. This is commonly referred to as the Pantone Matching System (PMS).

The PMS consists of nine basic colors (plus transparent white). When using PMS, you will work with a formula guide book and an ink scale, like the one shown in figure 15-10, which is used to measure the correct portions of the basic colors that produce the blend desired.



57.760

Figure 15-10.—An ink scale.

The various PMS blends are identified by numbers. For instance, to obtain light green, #368, you mix 12 parts of the basic yellow ink with 4 parts of the basic blue ink. The term *parts* refers to the weight of ink used. If you are mixing a pound or more of ink, full ounces would be the minimum amount used. If you required less than a full pound of ink, half ounces would be minimum amount used.

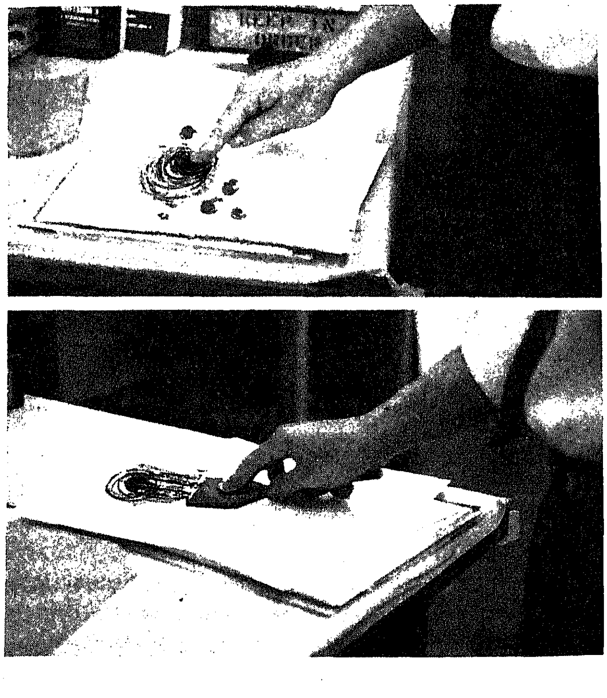
Your shop may not have such a system, or there may be occasions when you cannot use it to obtain a special ink color match. Therefore, you should know the basic methods of mixing ink colors.

In speaking of colors, you should understand several precise terms. These are hue, chroma, and value. The color of the ink, blue, red, etc., is known as the hue. Hue refers only to the color of the reflected light, and not to the amount reflected or to its intensity. Chroma refers to the intensity of the reflected color, its relative purity as compared to gray. Value refers to the amount of light reflected by the color, as compared to a maximum of white and a minimum of black. As a color is lightened, its value increases; as a color is darkened, its value decreases.

Several points of theory should be clear to you, before you do actual color matching. The coloring properties of ink are dependent upon the pigment. The color of a mass of ink, such as the appearance of ink in the open can, is known as masstone. The color of light reflected from a translucent film of ink, such as is laid down in offset printing, is known as undertone. The color of the printed image is a result of the combination of the reflection of the masstone and that portion of light transmitted through the ink by the paper, or the undertone. To make a good color match, both masstone and undertone must match. There are two methods of testing inks: the tapout and the drawdown. A tapout is done by placing a small, pea-sized amount of ink on a sheet of stock on which the job is to be printed, then working it with your fingertip in a circular motion, gradually extending the ink to a fine film at the edge. The center of the circle, containing the darkest ink, is the masstone. The thin film at the edge reveals the undertone. A drawdown is similar; a small amount of ink is placed on the sheet, then drawn into a long streak on the sheet with the blade of the ink knife. Both tapouts and drawdowns are illustrated in figure 15-11.

You should also determine whether an opaque or a transparent ink is required. If you are printing on colored paper stock, you should use an opaque ink to keep the color of the stock from blending with the undertone of the ink and possibly destroying the color balance. If you are overprinting a halftone, you will need a transparent ink so that the halftone image will show through. For most map and chart work, you will use transparent colors. Inks for full color (process) work are usually transparent, although some first-down yellows are opaque. The relative opacity or transparency of some commonly used inks is shown in figure 15-12.

Mixing a color with its complement will gray the resulting color. In mixing color, you must take care to avoid using component inks that contain the complements. For example, you know that a mixture of cyan (blue) and magenta (red) produces purple. There is none of the third primary color, yellow, in this mixture. Some blue inks tend toward greenish, while others are purplish; some red inks are on the orange side, while others tend toward the purple. A combination of the inks containing some yellow (a blue-green and red-orange) will give you a gray purple; the other inks will produce a truer purple.



57.447

Figure 15-11.—Tapout, above; drawdown, below.

It is always necessary to obtain the correct color, or hue, before proceeding to change its value or to change the purity, or chroma. Changing the value of a color is accomplished by adding black, resulting in a shade, or by adding white, resulting in a tint. Changing the chroma is done by adding the complementary color to gray the original color.

In mixing colored inks, you add the darker color to the lighter in small quantities. As you add color, you should mix it thoroughly and work it out, then tap it out or draw it down to check masstone and undertone before adding more color.

Color Harmony

As a Navy Lithographer, you will probably not be concerned with color harmony, which is the balance of color to make a printed piece pleasing to the eye. When you are required to run color, it will be according to some standard color plan, used for a specific purpose. The colors of various topographic features on maps, for instance, are standardized.

In those instances where color decisions are made in your shop, the following principles should be applied:

1. The warm colors (red, orange, and yellow) excite the eye. They are attention-getters. Yellow represents light, and attracts the eye best. Red is warmest and most exciting. It may actually be irritating to the eye.
2. The cool colors (blue, green, and purple) are restful and relaxing. Blue is coldest and most restful. Some blues and purples are so cool they actually repel the eye. Green is considered the most relaxing.
3. Strong colors (those with high chroma) are used when the color area is very small. As the size of the area increases, chroma should decrease; that is, the color should be grayed. You can obtain similar results by using tints (colors of high value) when large areas are to be covered.

Color	Relative Opacity	Permanence	Drying	Workability
Blues				
Alkali	transparent	fair	slow	excellent
Monastral (process)	transparent	excellent	good	fair
Milori (iron) (bronze)	semiopaque	good	good	good
Peacock	transparent	very poor	fair	fair
Tungsten (process)	transparent	good	fair	good
Browns				
Iron Oxide	opaque	excellent	good	poor
Para	semiopaque	good	fair	good
Greens				
Chrome	opaque	good	good	fair
Chrome Oxide	transparent	excellent	good	fair
Tungsten	transparent	good	fair	good
Milori	semiopaque	good	good	good
Oranges				
Chrome	opaque	good	good	good
Lake	transparent	poor	fair	poor
Molybdate	opaque	good	fair	excellent
Permanent	opaque	good	good	excellent
Purples				
Molybdate	transparent	good	fair	fair
Tannate	transparent	poor	poor	good
Tungsten	transparent	good	fair	fair
Reds				
Cadmium	opaque	excellent	good	poor
Lithol	semiopaque	fair	fair	good
Lithol Rubine	semiopaque	good	fair	good
Madder Lake	transparent	good	fair	fair
Phloxine (process)	transparent	fair	good	good
Red Lake	transparent	fair	good	good
Rhodamine (process)	transparent	good	fair	good
Scarlet	transparent	good	fair	fair
Toluidine	opaque	good	fair	good
Vermillion	opaque	good	good	poor
Watchung	semiopaque	good	good	good
Yellows				
Benzidine (process)	transparent	poor	fair	good
Cadmium	opaque	excellent	good	fair
Chrome	opaque	good	good	good
Hansa	semiopaque	good	fair	good
Lake	transparent	poor	fair	poor
Whites				
Alumina Hydrate	transparent	good	good	good
Gloss White	transparent	good	good	good
Lead oxide	opaque	good	good	good
Titanium	opaque	excellent	good	excellent
Zinc oxide	opaque	good	good	good

113.249

Figure 15-12.—Properties of colored inks.

4. When two colors are used, a primary and its complement present pleasing combinations. It is best to use the warmer color in the small areas and the cooler complement in the larger areas.

5. When black is used with a cool color, it should have a red undertone or have a small amount of red added. Conversely, if black is used with a warm color, the black should have a blue undertone or have some blue added.

INK ROLLER CARE

On your offset press the ink is distributed by a system of steel and composition or rubber rollers. Rubber rollers are made by attaching strips of rubber to hardened steel cores, then vulcanizing and curing them under pressure and heat. The roller is then ground down to the proper size on a lathe. Steel rollers are machined to the proper diameter and sometimes are plated to present a more ink-receptive surface.

The surface of rubber rollers must be waterproof and fairly resistant to the driers and vehicles in the ink. Some types of driers and vehicles cause swelling of rubber rollers, so these additives should be used with caution and in small amounts. When it is possible to do so, you should remove the rollers from the press, clean them thoroughly, and allow them to rest after the swelling occurs. Rollers should be stored in a cool dry place, as heat, moisture, and light may cause deterioration. Several sets of rollers may be kept on hand for each press, and they should be rotated from time to time. All rollers should be stored in racks (preferably vertical) when not in use, so that they will not develop flat spots from resting on a surface. If a rack is not available, rollers may be stored vertically, resting on the shaft end. However, care should be taken to prevent burrs on the shaft ends when the rollers are stored in this manner.

GLAZING AND STRIPPING

If the rollers of your offset press are not properly cleaned at the end of each work day, the ink vehicle and drier may be absorbed by the rubber of the rollers and dry to form a hard, shiny surface. This process is known as roller glaze. You can generally remove the glaze by washing the rollers with a solvent and fine pumice, followed with a lye water bath. A solution of 4 to 6 tablespoons of caustic soda (lye) in a gallon of water is adequate.

CAUTION

Lye is corrosive and can cause severe skin and eye burns, so you should wear rubber gloves and avoid splashing when working with the solution.

Stripping is another possible roller trouble. It occurs when the acid in the fountain solution makes the steel rollers ink repellent. The gum arabic used in the fountain solution is a natural desensitizer. When used to excess, the gum arabic will cause stripping. If this happens, the rollers must be counteretched so that they will again become sensitive to the greasy ink. You can use a solution of 2% nitric acid or a 28% acetic acid solution as a counteretch. After the rollers are washed with solvent, the acid etch is applied with a wad of cotton. The roller is then scoured with pumice powder and rinsed again with solvent before it is dried.

Stripping is almost always caused by excessive fountain solution, so the flow of the solution should be carefully regulated. The fountain solution should also be checked for proper acidity.

Some offset press manufacturers have copper-plated the steel rollers in the inking systems. This is because copper has a natural affinity for ink, while steel repels it. Chrome-plated steel rollers are often used in the dampening system in place of brass because chrome repels ink. If your presses are equipped with steel ink rollers, you may be able to reduce stripping problems by having these rollers copper-plated during your next yard overhaul or tender availability.

PROTECTIVE COVERS

A transparent fluorocarbon resinous material in the form of a tube or sleeve to be slipped over the ink rollers can also be used to protect these rollers. Once a cover has been slipped on a roller, heat (220 °F) is applied with a commercial hot-air gun, as shown in figure 15-13. The heat shrinks the cover and produces a tight fit. The roller is rotated during the shrinking process as indicated by the arrow in the illustration.

This cover has an excellent affinity for ink. It also reduces hickies, since it attracts and holds dirt particles. Furthermore, particles of the cover will not break off, to produce hickies, as sometimes happens when you are using unprotected composition or rubber rollers.

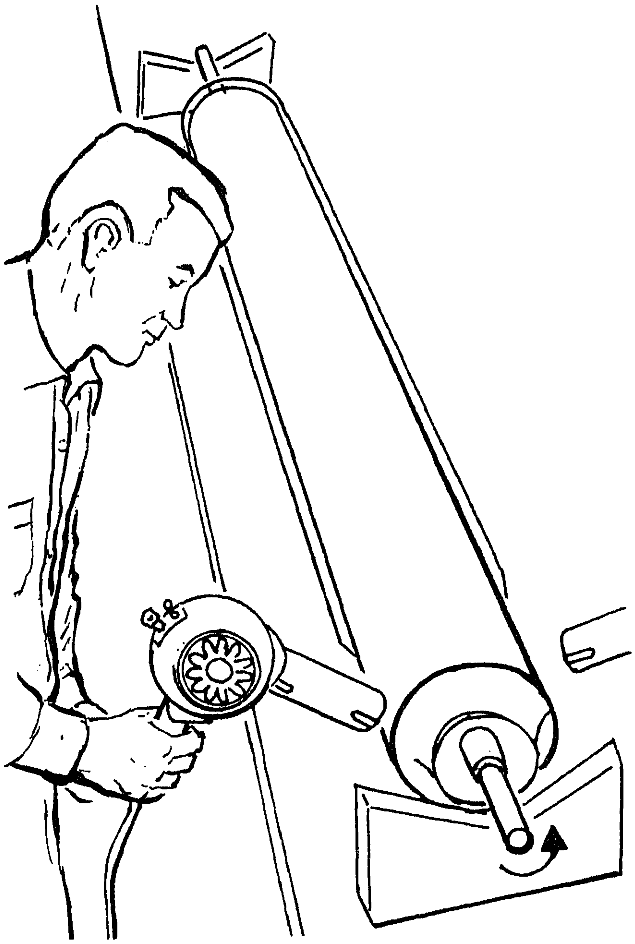


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Figure 15-13.—Applying the transparent fluorocarbon resinous material protective cover to an ink roller.

Washup solutions, varnish, and gum penetrate into some roller surfaces and cause them to become slick and glazed and to lose their affinity for ink. Metal rollers also lose their affinity for ink, and strip. Because the surface of this special cover is nonporous, it resists ink buildup and cleans completely so stripping, glazing, and pitting are eliminated. Since the rollers will not carry water or fountain solution, they cannot become desensitized and strip. The rollers can be cleaned easily and completely with any solvent. The covers eliminate the need for hand-scrubbing and the use of lye solutions.

These covers cannot improve a roller that is already in poor condition, however. The rollers to be covered must be ground and uniform in diameter, because an uneven surface may prevent proper roller contact and result in spotty inking. For this reason, only new or reground rollers can be covered. If you have the proper equipment on hand, you can cover the rollers yourself. However, if you do not, you can send the rollers out for covering. In either case, it is a good idea to have the rollers reground before applying the transparent fluorocarbon resinous material covers.

Although these covers can be used on form rollers, they sometimes cause aluminum plates to wear if the rollers are not carefully adjusted. These covers also tend to wear when a washup attachment is used against the rollers. Therefore, some shops do not cover the roller that will be contacted by the blade of the washup attachment.

These covers are manufactured in diameters ranging from 1.25 inches to 8 inches. The thickness of the material is 0.020 inch.

INK DIFFICULTIES

Before you can identify problems associated with the ink on the offset press, you must understand the definitions related to them. (Refer to table 15-1 as you study this section for specific inking problems and their solutions.)

Back-off refers to ink that does not follow the roller in the fountain. It may occur over the entire length of the roller or just in spots. *Chalking* occurs when the vehicle does not form a bond between the pigment and the paper and allows the pigment to powder or rub off the sheets. Inks *crystalize* by drying from the top down, forming a crust that repels other inks. *Embossing* of the blanket occurs when inks are so stiff that they impress the image into the surface of the blanket.

Emulsification of inks can occur in two forms. When the water emulsifies in the ink, small droplets of water are carried up into the film of ink on the rollers. Generally, this is not a serious problem. In some cases the image will become grayed, however, and the pressman may increase the ink flow, thus causing fill-in. In an effort to remedy this, the pressman may then increase the water flow, and a vicious circle has begun. When the ink emulsifies in the water, it backs up into the dampening system and is redeposited on the plate as an overall tint. This condition is more serious than water in the ink, and will often necessitate the washup of the entire dampening system.

Filling-in of the image is most noticeable in halftones and reverse images. Ink spreads from the image areas into the non-image areas, giving a muddy appearance to the halftones and plugging

Table 15-1.—Ink Problems and Remedies

Problem	Cause	Remedy
1. Back-off	1. Ink does not follow fountain roller	Work ink thoroughly before placing in fountain
	2. Ink too short	Work in No. 0 or 1 varnish (1/4 oz per lb)
2. Bleeding pigment (see Tinting)		
3. Chalking (often not noticed until job is run; if this is the case, overprinting is the only remedy)	1. Vehicle absorbed too rapidly to form bond	Add No. 8 or 9 varnish (body gum) (1/4 oz. per lb.)
	2. Not enough drier	Add paste drier (1/2 to 1 1/2 oz. per lb or liquid drier (1/4 to 1 oz per lb.)
	3. Wrong ink	Overprint with overprint varnish
4. Crystallization	1. Cobalt drier	Substitute paste drier
5. Drying on rollers	1. Too much drier	Reduce amount of drier
	2. Wrong formula ink	Change to slower drying ink
6. Embossing	1. Ink too stiff	Reduce body with No. 00 or 0 varnish (1/4 oz per lb)
	2. Too much drier	Reduce amount of drier or change from liquid to paste drier
7. Fill-in	1. Too much ink	Reduce ductor dwell or tighten fountain keys
	2. Ink too soft	Add No. 8 or 9 varnish
8. Glazing	1. Dried ink on rollers	Clean rollers thoroughly with pumice and lye water
	2. Dried ink on blanket	Clean thoroughly with solvent and pumice
9. Hickies	1. Particles of dried ink	Remove all skin from ink before placing in fountain
	2. Paper dust	Clean edges of paper pile
	3. Dirt from overhead	Clean overhead above press

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Table 15-1.—Ink Problems and Remedies—Continued

Problem	Cause	Remedy
10. Livering	1. Poor ink formulation	Replace ink in fountain
	2. Alumina hydrate used as extender	Replace ink, use blanc fixe or gloss white
11. Misting	1. Ink too soft	Add No. 8 or 9 varnish
	2. Press speed	Slow down press
	3. Too much ink	Reduce ductor dwell or tighten fountain keys
12. Mottling	1. Too much ink	Reduce ink film; increase intensity of color
	2. Ink too greasy	Add No. 5 or 7 varnish to increase body
13. Offset	1. Too much ink	Reduce at fountain
	2. Not enough drier	Add cobalt drier (1/4 to 1 oz per lb) or paste drier (1/2 to 1 1/2 oz per lb)
	3. Fountain solution too acid	Reduce acidity to pH of 4.5 to 5.5
	4. Ink too heavy	Reduce with No. 0 or 00 varnish
	5. Static electricity	Use static eliminator or tinsel
14. Picking	1. Ink too tacky	Reduce body with No. 0 or 00 varnish
	2. Poor paper quality	Replace if possible; reduce ink as above
15. Piling	1. Ink too stiff	Reduce with No. 0 or 00 varnish
	2. Ink emulsified	Clean up; adjust water and ink
16. Plate Wear	1. Too much drier	Change to paste drier; use less
	2. Fountain solution too acid	Adjust to pH of 4.5 to 5.5
	3. Too little ink	Increase ink flow to protect image
17. Poor distribution	1. Ink too stiff	Reduce with No. 0 or 00 varnish
	2. Glazed rollers	See above
	3. Uneven flow from fountain	Adjust fountain blade

57.682.2

Table 15-1.—Ink Problems and Remedies—Continued

Problem	Cause	Remedy
18. Poor trapping	1. Cobalt drier	Use paste drier in all but last-down color
	2. Improper tack	Adjust tack with varnish: first down color tackiest, others successively less tacky
	3. Too much time between colors	Run other colors as soon as possible; generally as they set-up
19. Scum	1. Ink too soft	Increase body with No. 4 or 5 varnish
	2. Too much ink	Reduce flow at fountain
	3. Improper fountain solution	Adjust pH to 4.5 to 5.5
	4. Too much drier	Reduce amount of drier
	5. Dirty dampener rollers	Replace roller covers
20. Show-through	1. Paper too absorbent	Replace paper if possible
	2. Ink thinned with solvent	Replace ink with one thinned with No. 0 or 00 varnish
21. Slow drying	1. Not enough drier	Add proper drier
	2. Paper too acid	Replace if possible
	3. Fountain solution too acidic	Reduce to pH of 4.5 to 5.5
22. Smudging	1. Not enough drier	Add proper drier
	2. Drier not mixed thoroughly	Remove ink from fountain and rework
23. Stripping	1. Glazed rollers	See above
	2. Desensitized rollers	Etch rollers
	3. Too much water	Adjust water/ink balance
	4. Fountain solution too acidic	Adjust pH to 4.5 to 5.5
24. Surface scratch	1. Not enough drier	Add drier, cobalt if possible
	2. Too much ink	Adjust ink flow
	3. Non-resistant ink	Add wax compound (only to last-down ink)

57.682.3

Table 15-1.—Ink Problems and Remedies—Continued

Problem	Cause	Remedy
25. Tinting	1. Ink too soft 2. Fountain solution too acidic 3. Not enough water	Add No. 5 or 7 varnish Adjust to pH of 4.5 to 5.5 Clean up and adjust ink/water balance

57.682.4

up the fine lines and serifs in reverses. *Roller glaze* is an overall glossy appearance on rubber and composition rollers. It consists primarily of dried varnish. When inking properly, the rollers should have a velvetlike sheen. *Hickies* are small doughnut-shaped spots in the image areas, caused by dried ink, paper dust, or other dirt.

Livering is a generally uncorrectable condition of the ink, caused by a reaction between additives and the vehicle. It is characterized by a gelatin- or liverlike appearance of the ink. *Misting* refers to the action of a soft ink in breaking away from the rollers and spraying about the pressroom. *Mottling* is a term used to describe an uneven appearance of the printed image. It is most often seen in large solid areas. *Offsetting* describes the transfer of fresh ink from the front of one sheet to the back of another when they are stacked together. It is sometimes called "setoff" to distinguish the problem from the printing process. Picking is a condition in which the surface of the paper is broken or torn due to the stiffness of the ink. It occurs most often with cheaper grades of coated stock. Piling occurs when the ink does not transfer from the plate to the blanket or from the blanket to the paper. As the ink builds up, it will emboss the blanket and possibly ruin the plate.

Ink is being poorly distributed when it does not flow evenly over the roller surfaces. Poor trapping refers to the inability of the first colors printed in multicolor work to accept the successive inks. Scum is a localized condition of the plate in which the ink adheres to non-image areas of the plate in certain spots. Show-through refers to a condition in which some of the pigment and vehicle are absorbed by the paper to create a reverse image on the back of the sheet. It is often confused with offset; but it is always in register, whereas offset is generally not in register.

Smudging is similar to chalking, but the pigment is not completely rubbed off; it is transferred or smeared over another portion of the sheet in the partially dried vehicle. Stripping is the refusal of the rollers to take ink. It occurs on the rubber or composition rollers that have become glazed and on steel rollers that have become desensitized to ink. It may be an overall condition or it may be spotty. The printed image may be scratched after the ink has dried. The condition may be confused with chalking, but it is only the surface of the image that is affected. It is primarily a problem in package printing.

Tinting is the overall deposit of ink in the non-image areas. The tint may be wiped from the plate with a light touch of a sponge or fingertip, but it will probably reappear when the dampeners are dropped on the plate. It differs from scum in that scum cannot be wiped off easily, and generally does not reappear.

SUMMARY

In this chapter, the products of paper and ink were presented. Together, these two products represent the most influential items that affect the visual quality of your final printed product. As a Lithographer, you must be prepared to select the ink and paper best suited for the printing jobs going through your print shop.

The manufacturing process of paper starts with one or more of the four classes of pulp. They are ground wood pulp, recycled paper pulp, ground and cooked old rags pulp, and a sulfite pulp process. Additives are combined with the pulp to produce most of today's papers. The additives are referred to as sizing, loaders and fillers, colorings, and other special additives.

These additives give individual characteristics to the paper.

Special coatings are sometimes added to papers as they go through the papermaking process. Coated papers have the smoothest possible surface on which you can produce the highest quality halftone image.

The term *finish* or *finishing* is the last step in the papermaking process. In this step, the final appearance and texture of the paper is produced.

In the papermaking process, the grain of the paper is established by the movement of the screen in the papermaking machine. As the screen moves, it agitates the pulp fibers, alining them parallel to the length of the paper.

The paper grain is important because it gives strength to the paper, thus making the paper hold up better as it is folded or used for close register.

Most papers are made with two distinct faces. The face that contacts the screen of the papermaking machine is referred to as the wire side, while the other side, which passes against felt rollers, is called the felt side. The felt side is the best side for the printed image.

Basic sizes of paper (its area) are used to standardize stock sheet sizes. These basic sizes relate to the use of different papers and the different presses used to print the sheets. The basis weight of paper refers to a certain quantity of paper (generally 500 sheets). The information used for identifying papers, along with the basic size, helps to avoid confusion when you are discussing various papers.

The term *equivalent weights of papers* is used by the lithographer when comparing different papers. This is because it is sometimes necessary to substitute one paper for another.

The term *bulk* is used to inform the Lithographer of how many sheets would be in a stack of paper 1 inch high. The thickness, or caliper, of paper refers to the thickness of a single sheet of a given paper.

The three divisions of papers used in the printing industry are (1) commercial and book papers, (2) packaging and boards or cardboards, and (3) newspapers. Although you will work primarily with the papers in the first division, you should still have a knowledge of all three divisions because you will at some point work with the papers in the others.

Commercial and book papers can be either coated or uncoated. They also vary in quality and thickness. Cardboards is a term that identifies a thick paper. Newspapers are inexpensive, low-quality paper. They are intended this way because of their short period of use.

Printing inks are made up of pigments (the coloring matter), vehicles (which carries the pigment), and additives (which modify the other ingredients). The different pigmentations are used to produce a full range of colored inks. These colored inks are all available direct from the manufacturer. As the vehicle in the ink varies in viscosity, it gives the individual ink its body or thickness. The materials used as additives in ink may range from driers, waxes, anti-skinning agents, and retarders, to perfumes.

Although ink is manufactured with pigmentation, vehicles, and additives, its ingredients may separate if the container of ink is stored. Therefore, you may wish to mix the ink, or work it out, on a flat surface to make sure all the ingredients are well mixed before putting the ink in the ink fountain. Also, you may want to mix different inks together to change the color.

You can also add more of the same or different vehicles or additives to your ink. This, of course, you would do to change the properties of ink so that the ink would react in a special way.

Because of the properties of ink, it affects the surfaces of the ink rollers on the press. Therefore, the care of the ink rollers is important, not only to ensure the quality of each of your printing jobs but also to extend the life of the ink rollers.

There are remedies for almost all of the difficulties you might encounter when dealing with lithographic inks. At the end of this chapter, you will find table 15-1, which identifies the terms and remedies for ink difficulties.

Bindery equipment will be presented in the next chapter.

CHAPTER 16

BINDERY EQUIPMENT

The last stop for nearly all jobs that go through a lithographic shop takes place in the bindery section. Bindery work includes such operations as cutting, stapling, stitching, folding, gathering, collating, padding, drilling, and wrapping the completed printing job. Naturally, the number of bindery operations performed depends on the requirements of the job. A simple form used in the ship's administration office may only need to be padded and wrapped in the bindery to complete it. On the other hand, Welcome Aboard booklets for new personnel reporting aboard your command may need to be folded, collated, stitched, trimmed, and wrapped before they are complete. But the majority of the time, the bindery or finishing operations will be a small, but important, part of the whole job.

Regardless of the number of bindery operations (steps) or the length of time it takes to process a job through the bindery, you must keep in mind the importance of doing the work correctly. One mistake in measurement or instruction in the bindery could mean that the entire job will have to be rerun (reprinted). Reruns are not only a waste of time and materials, but they can disrupt the workload schedule in the shop.

PAPER CUTTERS

The paper cutter shown in figure 16-1 is typical of the hand-operated paper cutters found in many lithographic shops. Hand-operated paper cutters are also called lever cutters, because a lever is used to force the cutter's knife blade through the paper. The knife is lowered in a slicing manner when you are pushing the lever handle down and is raised to an upright position when you are returning the lever.

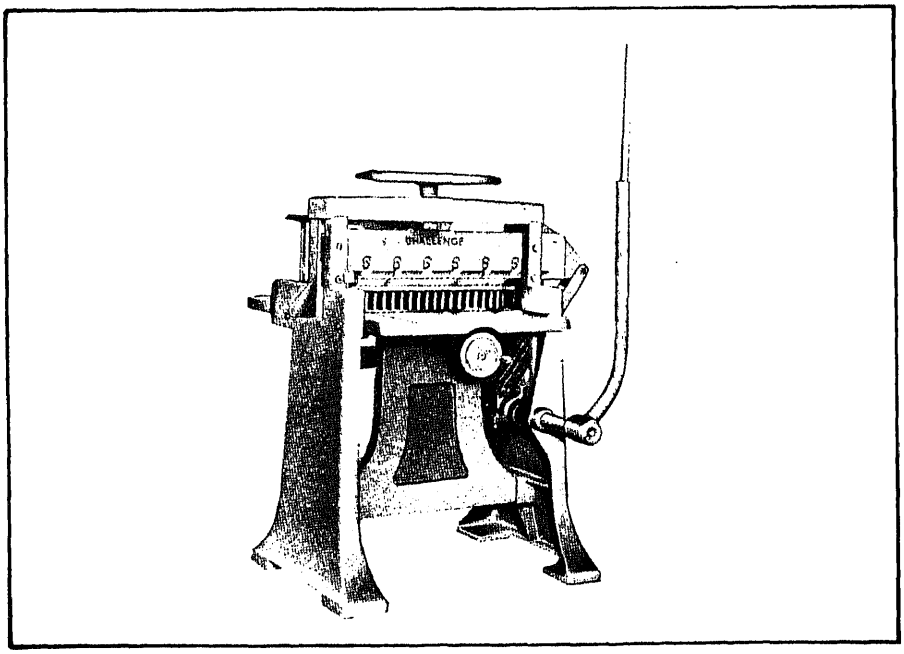

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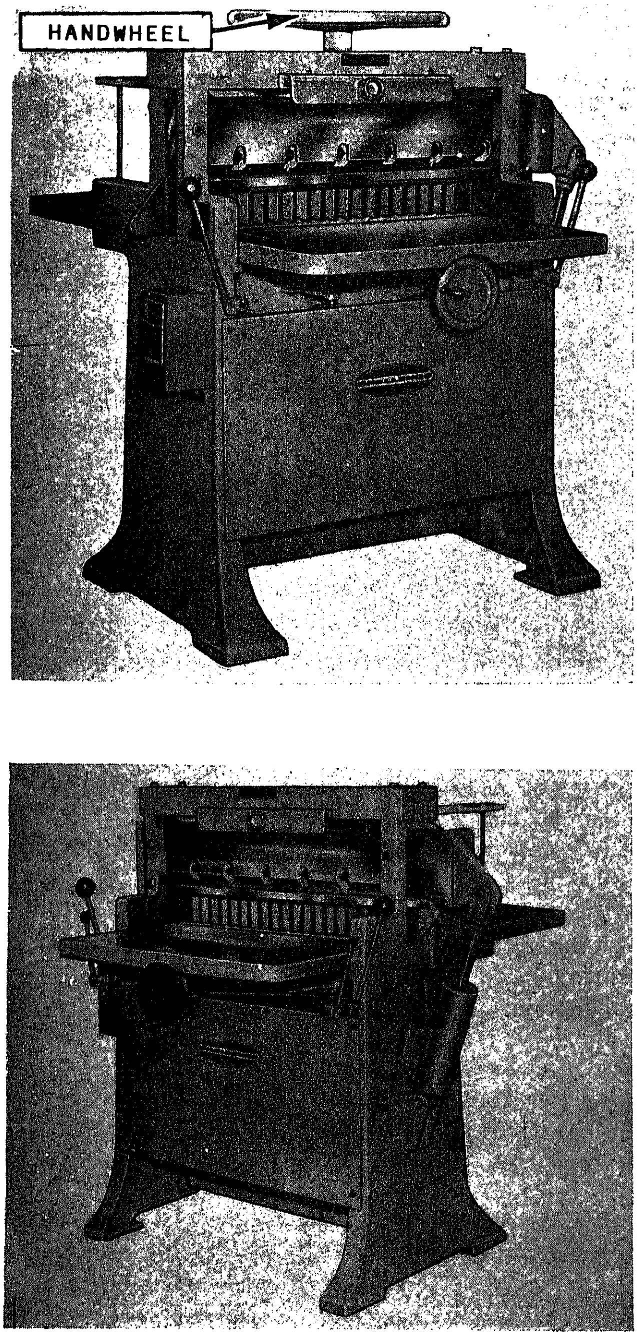
Figure 16-1.—Hand-operated paper cutter.

The paper cutters shown in figure 16-2 are similar to hand-operated (lever) cutters except that they are power operated. To lower the knife blade, you must push or pull two levers or buttons, which requires use of both of your hands. This is a safety feature that ensures that you will always have both hands clear of the knife when the cut is being made.



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With either type of paper cutter—lever or power—you should use a clamp to prevent the lift of paper from slipping while you are making the cut. A lift of paper is the term used here to describe the stack of paper that is placed on the cutter table. On some cutters the clamp is raised and lowered by means of a large handwheel on top of the cutter, shown in the top view of figure 16-2. On other models, usually the power-equipped type, the clamp automatically lowers just before the knife descends through the paper. There are handwheel-operated clamps on power cutters also.

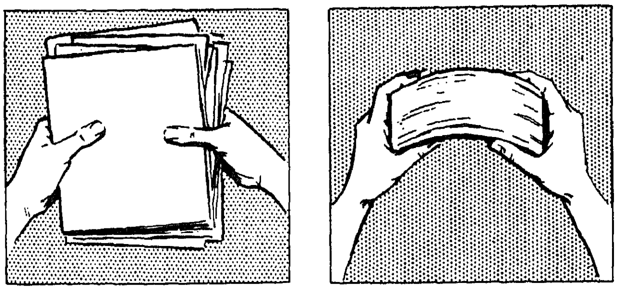
You can place a piece of chipboard (light card stock used as backing for pads or tablets) on the top and bottom of each lift of paper before cutting it. The chipboard on the top will prevent the paper clamp from indenting and damaging the sheets as the clamp puts pressure on them. The chipboard on the bottom of the lift assures that the cutting knife will cleanly pass through the paper to the cutting stick.

The cutting stick is a square piece of hardwood or plastic that fits into a groove across the cutter table. It prevents the knife blade from being damaged when it passes through the last sheet of paper. The knife cuts through the paper and slightly into the stick with each cut. In time, the stick will become worn, and the cutter will then stop cutting completely through the lift of paper. You then will have to turn the stick over to another one of its sides. Once all four sides have been used, you will have to replace it. A cutting stick may easily be removed from the groove in the table by prying the stick up from either end of the table with a screwdriver.

Continual use of the cutter causes the knife to become dull. A dull knife or one that has become chipped will affect the quality of your cuts, leaving ragged or rough edges on the lift of paper. You may sharpen the knife if you have the proper equipment and the necessary training. Every shop should have at least one spare knife blade available to replace the one in use.

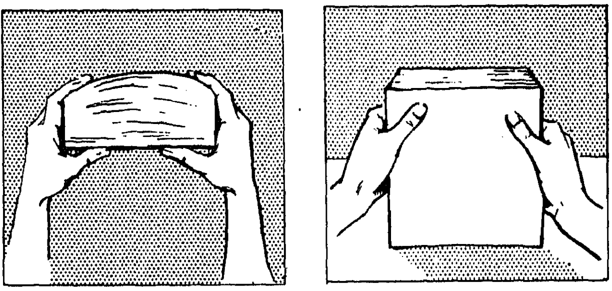
Unlike changing a cutter stick, the replacement of a cutter knife is a difficult job. You should never attempt to remove or replace a cutter knife by yourself. The knife must be adjusted so that it rests evenly, and just barely on the cutting stick. Consult the manufacturer's instruction manual for the correct knife-replacement procedures for your particular cutter model, and remember all

OPERATING A PAPER CUTTER



TAKE TWENTY-FIVE TO TWO HUNDRED UNEVEN SHEETS.

BEND STACK OF PAPER TO INTRODUCE AIR.



STRETCH BOTTOM SHEETS TAUT TO INTRODUCE A BLANKET OF AIR BETWEEN EACH SHEET.

DROP PAPER AGAINST TABLE TO JAR UNEVEN SHEETS IN PLACE.

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Figure 16-3.—How to jog small sheets.

Sheets of paper are loaded onto the cutter table in small stacks, or lifts. The height of the lift varies according to the type of paper and the cutting (trimming) capacity of the cutter.

The sheets are jogged (evenly aligned) against an adjustable metal back gauge and to one side of the cutter table. The distance between the back gauge and the point where the knife descends determines the measurement of the cut. The knife position never changes, but you can move the back gauge forward or backward. On some cutters, this movement is done by turning the handwheel, moving a lever, or pushing buttons, located at the front and/or below the cutting table.

On most cutters, the cutting distance is indicated on a sliding metal tape that passes from the back gauge through a viewing window at the front of the cutter. Most of the tapes are calibrated in sixteenths of an inch. This makes it possible to quickly and accurately position the back gauge.

On cutters not equipped with a sliding-tape measuring device, you must use a wooden ruler to measure the distance from the back gauge to the point where the knife indents the cutting stick. Never use a metal ruler when making measurements on and around the paper cutter, because you may forget and leave it on the cutting table in the path of the knife when the cut is being made. This metal-to-metal contact will damage the knife.

Once you have set the back gauge, you must lock it in position with a locking screw or lever that is located on the back gauge handwheel. The locking device prevents the back gauge from moving as the lift of paper is jogged against it. Naturally, before the cutter can be reset for a different cut, the locking device must be released. When you are jogging the paper against the back gauge, don't use excessive force, or you may eventually misalign the back gauge.

Each lift should be jogged until the edges of the sheets are as even as possible. (See fig. 16-3.) Once you get the hang of it, you will find that jogging the paper is a fairly simple process. Large sheets of paper, however, are more difficult to handle; therefore, you should riffle the lift slightly to introduce a blanket of air between the sheets. Then, raise the lift slightly and shove the stock loosely against the back gauge and side of the cutter simultaneously. Many paper-cutter operators use a smooth, rectangular block of plastic or wood to tap the exposed edges of the lift of paper. This helps to ensure that the stock is resting firmly against the side and back gauge of the cutter. You will also find that if you fold large sheets in the manner shown in figure 16-4, it will be easier for you to handle them when you are loading or unloading the cutter.

How to Trim Paper

When you are trimming paper on four sides with a paper cutter, remember to make the first

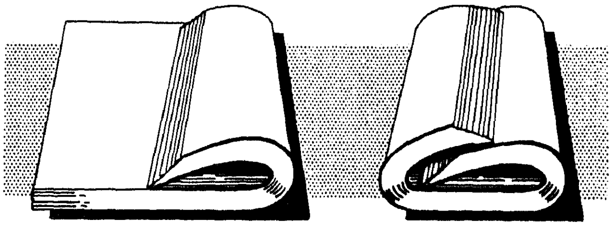

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Figure 16-4.—Overlapping large sheets in this manner make them easier to handle.

two cuts slightly oversize. This will allow for a little trim on the other two sides when you trim the lift of paper to the final size.

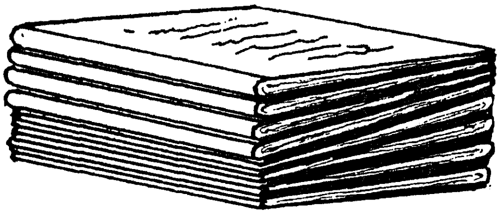
When you make your first cut, always place the most even side of your paper against the back gauge of the cutter. When you make your second cut, turn the paper and jog the smooth cut edge against the side guide of the cutter so that this cut will be at a true angle to the first cut. When making your third and fourth cuts, set the back gauge of the cutter to the final dimensions for the sheets. It is not necessary to push the paper against the side guide after the second cut. If you use only the back gauge, you should try to center the stock on the cutter table to minimize pressure on the weaker ends of the gauge.

How to Trim Books

When trimming books or pamphlets, you should set the cutter for the desired distance and place them in the cutter with the bound edge (backbone) toward the back gauge. There are cutter attachments, called book guides, that can be clamped onto the back gauge. These guides will hold down the back edges and prevent the books from slipping. If book guides are not available, you should bring the cutter clamp down slowly while lightly forcing the books against the back gauge with a block of wood or plastic. Cut all books along the face (right side) before resetting the cutter. Then reset it for the foot (bottom) cut.

To equalize the pressure of the clamp on the stack of books during the head and foot cuts, you should flop the top half of the stack over from right to left. (See fig. 16-5.) This will give the stack of books an equal amount of backbone on each side and allow the clamp to exert its pressure evenly.

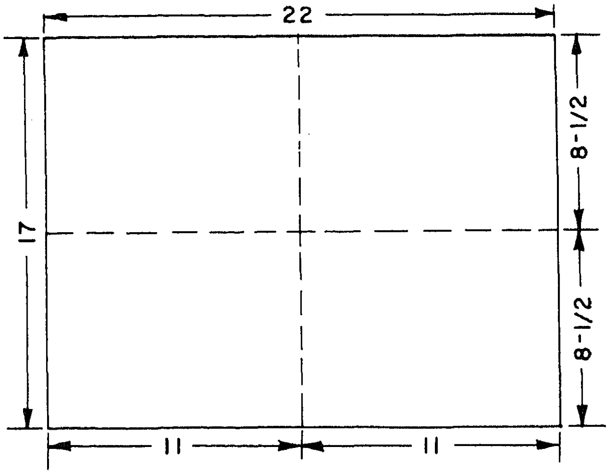
After making the foot cut, reset the back gauge and make the head cut. Leave the books stacked just as they were on the cutter for ease in wrapping after the job is completed.



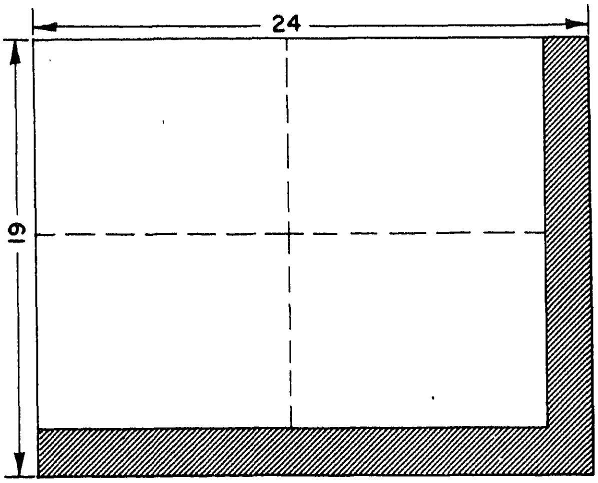
On some paper cutters, the back gauge is built in three sections, which may be set (positioned) together or separately. You can set the center section for trimming the face of the books, and the side sections for trimming the head and foot. Using this method, you can work out a production system that will produce a stack of books trimmed on three sides every time the knife descends.

Cutting From A Stock Sheet

Estimating how much paper stock will be required for a particular job is an important



You can cut four 8½" × 11" pieces from a 17" × 22" stock sheet with no waste . . .

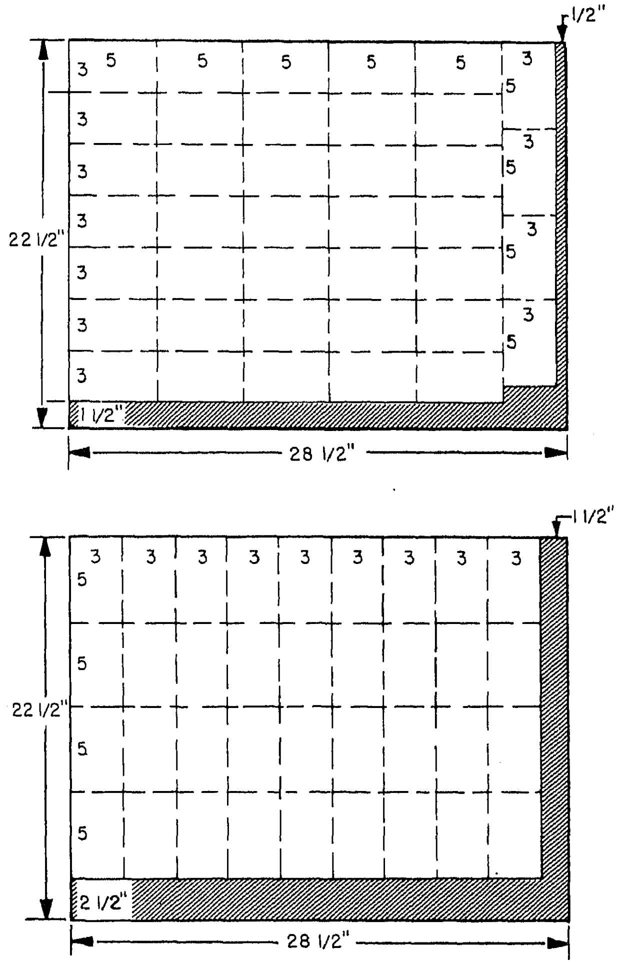


. . . While the same cut from a 19" x 24" sheet leaves considerable waste.

operation. You must cut the largest possible number of pieces from the stock or prime sheet.

If it is necessary to cut the stock sheet in halves or quarters, you will have no trouble. (See fig. 16-6.) But if the required size doesn't cut out of the stock sheet evenly, you must figure out how to cut the sheet with the least amount of waste.

Suppose you need to cut 3-inch by 5-inch cards from 22 1/2-inch by 28 1/2-inch stock. You should figure the 3-inch cut along both the 22 1/2-inch and the 28 1/2-inch dimensions. You should also try the 5-inch cut both ways to see which works out better (fig. 16-7). You will find that in the first case, 3 goes into 22 1/2 seven times and that 5 goes into 28 1/2 five times. This means that you can make seven 3-inch cuts along the 22 1/2-inch side and five 5-inch cuts along the 28 1/2-inch side. Seven times five is 35, which is the number of 3 by 5 pieces that can be cut from one 22 1/2-inch by 28 1/2-inch stock sheet.

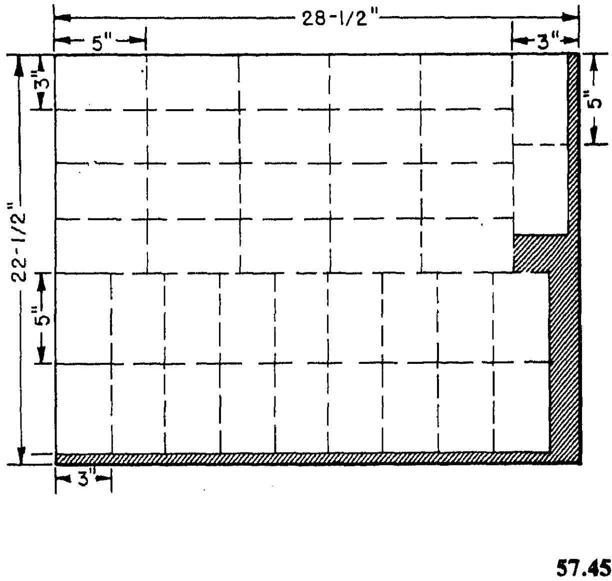


57.456

In the second case, four 5-inch cuts can be made along the 22 1/2-inch side, while nine 3-inch cuts can be made on the 28 1/2-inch side. Nine times four is 36—so you would get more pieces by using the second method.

However, the trim must also be considered. In both cases, you would have something left over after each cut. In the first case, the trim amounts to 1 1/2 inches on one side and 3 1/2 inches on the other. In the second case, it is 2 1/2 inches on one side and 1 1/2 inches on the other. You should make a diagram of the stock sheet, like that shown in figure 16-7, to see if you can find a way to use your trim. You will notice that the trim in the second case is useless, but in the first case it can be used to make 4 extra pieces of the required 3- by 5-inch size. You can add these to the 35 you already have, making a total of 39 pieces by this method.

But this business is tricky. If you use a different arrangement like the one in figure 16-8, you will find that you can get 40 pieces out of the sheet. Try several arrangements—then use the one that will give you the most pieces.



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Figuring Stock Sheets Required

Once you know how many pieces can be cut from a single stock sheet, it is a simple matter to determine how many stock sheets will be needed for a job. Just divide the total number of pieces required by the number of pieces you can cut from one stock sheet. For example, suppose your job calls for 15,000 finished pieces size 3 inches by 5 inches. As you have just seen, you can get 40 such pieces from a 22 1/2-inch by 28 1/2-inch stock sheet, so divide the 15,000 by 40. This gives you 375, which is the number of stock sheets you will need. Of course, you must allow extra sheets for spoilage. Cutting a few extra sheets at the beginning is cheap insurance against an incomplete job or a press shutdown to wait for additional paper. You should allow, as a general rule, about 10 percent for waste on runs of 500 sheets or less, but on the longer run jobs this can be reduced to 2 to 3 percent.

CARE OF THE CUTTER

Under normal conditions, little maintenance is required for paper cutters. However, after you have made a cut with the paper cutter, watch for a downward creep of the knife blade after you have returned it to its original (up) position. This movement signals that the clutch mechanism, which operates similarly to an automobile brake, is wearing and that it requires adjustment. Since the adjustment procedures vary from one type of cutter to another, consult the operator's manual for the adjustment instructions for the particular cutter in your shop.

The cutter table and other machined surfaces should be cleaned monthly. A light coat of wax

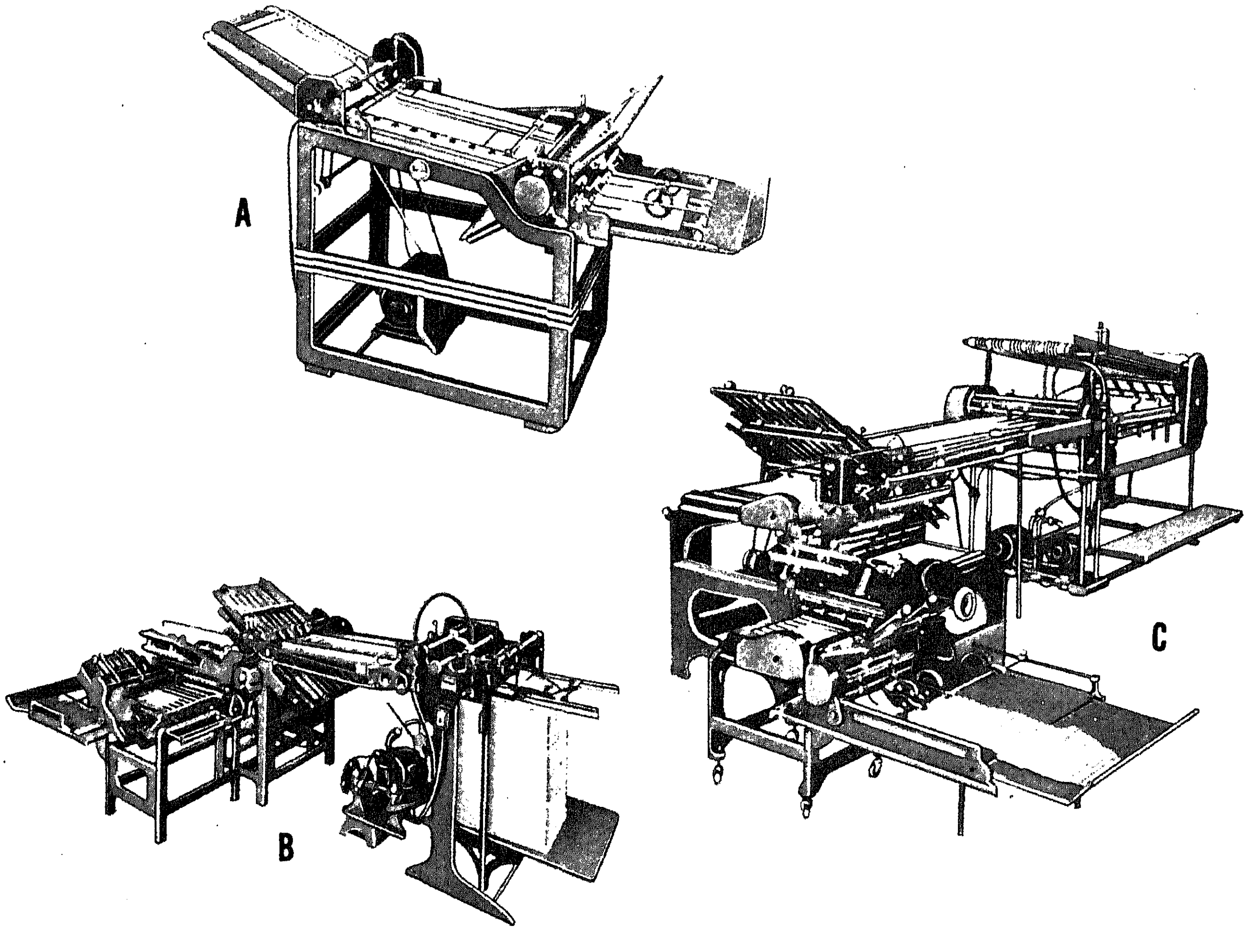

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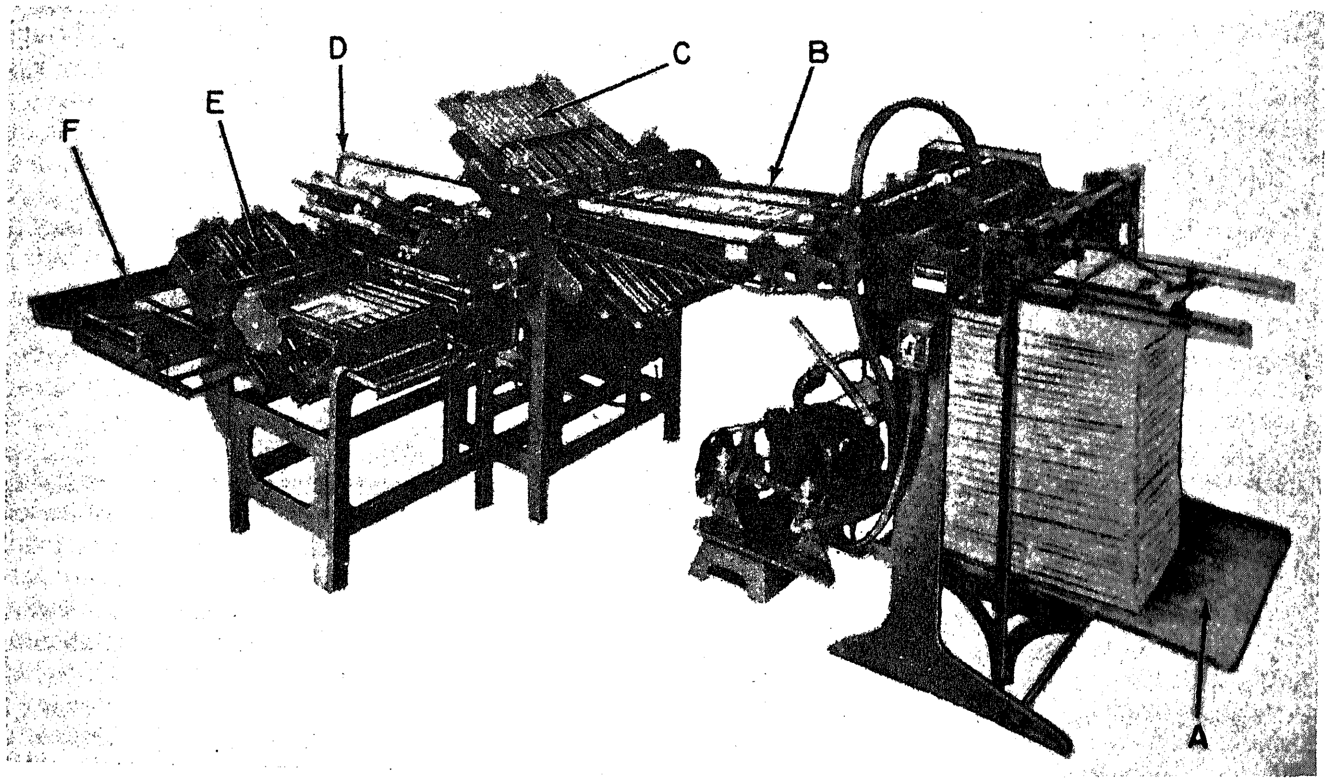
Figure 16-9.—Three types of folders: (A) friction feed; (B) pile feed; and (C) continuous feed.



A. **Feeder**
B. **Register Table**
C. **First Fold Unit**
D. **Second Fold Unit**
E. **Third Fold Unit**
F. **Delivery Unit**

57.461X

Figure 16-10.—Major components of a large, pile-fed folding machine.

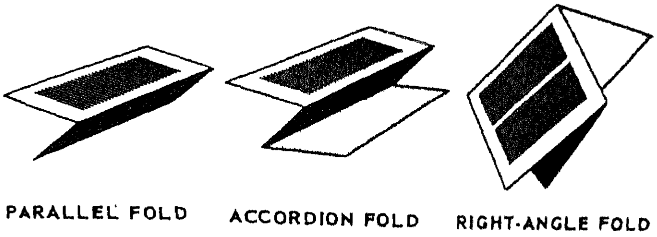
should be applied to the table surface after it has been cleaned. In addition to protecting it from rust, the wax provides a smooth, hard coating to the table.

FOLDING MACHINES

In large lithographic shops, folding is a major bindery operation. Large folding machines similar to those shown in figures 16-9 and 16-10 are used to fold large size press sheets, including 16- and 32-page signatures, maps, and charts. In addition to the folding units, large folders are often equipped with attachments for trimming, perforating, scoring, and pasting of the sheets. If your folder is so equipped, these operations may be done quickly and simply in one pass through the folder.

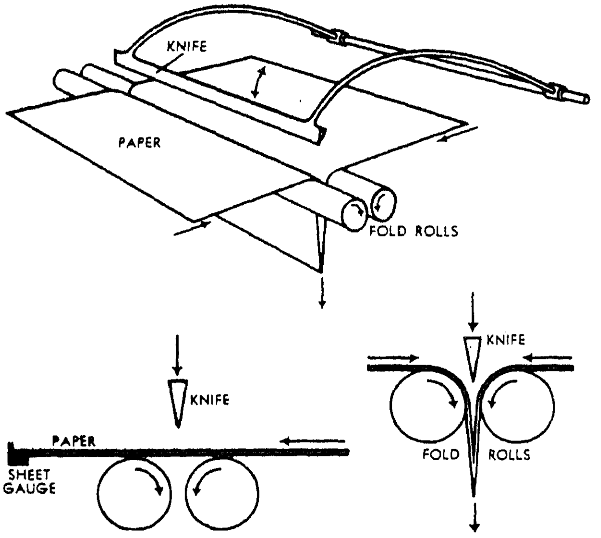
Smaller printshops, including most shipboard shops, have less demand for folding work. In many cases, their folding workload can be handled by hand or by the use of a smaller tabletop folding machine.

Figure 16-11 shows the types of folds that may be made on a folding machine. Parallel folds



57.458

Figure 16-11.—Types of folds. Parallel folds consists of one or more folds in the same direction. Right-angle folds consist of two or more folds in different directions. An accordion fold is generally used on maps and charts.



57.459X
Figure 16-12.—How the knife folder operates.

consist of one or more folds in the same direction, and right-angle folds consist of two or more folds in different directions. Only one folding unit is required to produce parallel folds, but the machine must have two folding units if it is to produce right-angle folds. If it has only one folding unit, after the sheets have been folded once, they must be run through the folder a second time to produce the right-angle fold.

TYPES OF FOLDERS

There are two basic types of folding machines: knife folders and roller (buckle) folders. Both types produce the fold by forcing the paper between rollers, as shown in figures 16-12 and 16-13. The roller folders are more versatile and are the type you will operate in the Navy.

LARGE FOLDING MACHINES

Large folding machines consist essentially of a feeder, a conveyor or register table, which is similar to the table feed on an offset press, one or more folding units, and a delivery unit. (See fig. 16-10.)

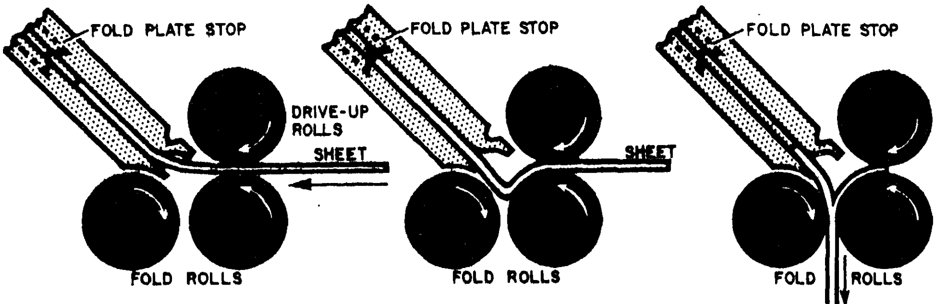
Feeder Units

There are three types of feeder units found on folding machines: friction, pile, and continuous.

On the machines equipped with the friction feeders, the paper stock is fanned out and placed in an inclined feed tray. Gravity moves the leading edge of the top sheet of the fanned-out pile against a rotating rubber wheel, which forces the sheet onto a register table. Moving conveyor tapes or rollers then carry the sheet down the table to the folding unit. Some friction-fed folders have only one folding unit and can produce only simple parallel folds; others have two units and can produce both parallel and right-angle folds. The sheets come out of the folding unit folded and ready for packaging.

You can load the friction-type feeder with even more sheets while the folder is in operation by inserting a fanned-out lift under the stock being fed.

The pile feeder shown in figure 16-10 is similar in many ways to the feeder on the offset press. The paper is loaded onto an elevating platform that raises automatically as the sheets are fed into



the machine. A pile-height governor regulates the height of the stack and also helps control the sheets as they float from a blast of air caused by the blowpipe at the front of the pile. A revolving suction wheel picks up the top sheet from the stack and forces it under a set of rubber rollers and a caliper and on to the register table. If more than one sheet passes under the caliper, the caliper will bind and trip off the suction to stop the sheets from feeding.

Since the movement of the side guide on the register table is limited, the stock is generally aligned with the side guide. This means that the sheets are generally positioned on the left side of the feed table, rather than centered on it.

The continuous feeder has the same features for separating and feeding the stock as the pile feeder, but the stock must be loaded into it in a different manner. You must stop the feeder to load the pile feeder, but the continuous feeder can be loaded while the machine is running. You simply place a hundred or more sheets on the top loading board, fanning them out to start the sheet separation. Conveyor tapes then carry the sheets, in a continuous stream, down from the second-story loading board, to a suction wheel, which separates the sheets and forces them onto the register table one at a time. The signatures must be loaded upside down on this type of feeder to be in the correct position when they reach the suction wheel.

Register Table

The register table is similar to the feedboard on the offset press. It is equipped with a series of conveyor tapes or steel rollers that run diagonally to carry the sheet to the left against a side guide equipped with a series of glass or metal balls. These balls help control the speed and registration of the sheet as it travels down the register table. There are also various hold-down rods and paper guides that aid in controlling the sheets.

Folding Units

At the end of the register table, the sheet passes between two rollers that force it into a metal chute called a fold plate. The sheet travels up the chute until it is stopped by a metal bar, known as the fold plate stop. Since the sheet can go no farther, it buckles and passes through the folding rollers below it. These rollers crease the sheet to complete the fold and also force it to travel on. The fold plate stop is adjustable; you can raise or lower it to regulate the distance the sheet travels up the chute, thus controlling the width of the fold.

The adjustment of the rollers in the folding unit is very important. If the rollers are too loose or if they have more pressure at one end than at the other, they will allow the paper to slip, and the fold will be crooked. The roller pressure varies according to the type of stock you are running. A heavy stock folded against the grain generally requires more pressure than light stock.

If the sheets being folded are small and the stock is not too thick, the rollers in all folding units can be set for constant pressure (in contact with one another). But if the sheets are fairly thick and bulky after they have been folded in the first folding unit, the rollers in the second and third folding units should be set for suspended pressure (separated by a distance equal to the thickness of the folded signature) to prevent excessive bounce, wrinkling, and splitting of the stock.

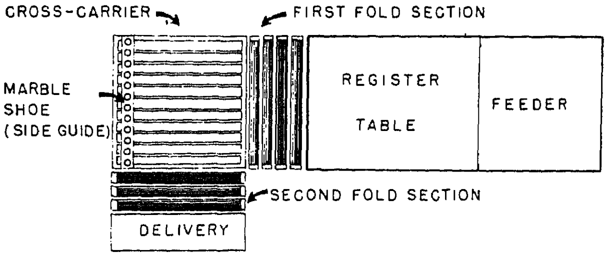
Deflectors

If another fold is to be made in the same direction, after the sheet leaves the first fold plate it passes into a second fold plate, where another fold is made. But if no other folds are to be made in this direction, the openings in the subsequent fold plates are covered with metal bars, called deflectors. The deflectors prevent the sheet from entering the fold plates, and the sheet passes through the remaining rollers without being buckled or folded.

After the sheet leaves the first folding section, it travels on to the next folding section for additional folds (or if no more folds are required, out to the delivery unit).

Cross-Carriers

If a right-angle fold is required, as the sheet comes out of the first folding section,



57.468

Figure 16-14.—Diagram of a folder having cross-carriers at a 90-degree angle to the first fold unit.

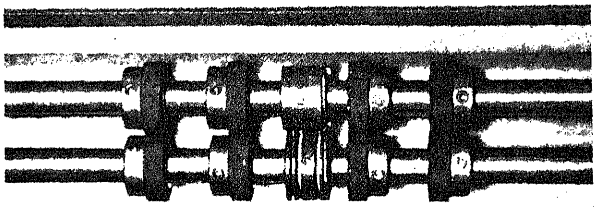
it travels onto a series of metal rollers called cross-carriers. The cross-carriers take the sheet to another side guide that consists of two revolving wheels. These wheels change the direction of the sheet and force it into the second folding unit.

Another type of cross-carrier, consisting of a powered roller set at a 90-degree angle to the first folding section, is shown in figure 16-14. In this type of carrier, the inertia of the sheet being ejected from the first unit forces the sheet under a set of hold-down marbles and against a side guide. The side guide and marbles register and control the sheet as it is carried to the next fold unit by the cross-carrier rollers.

Scoring Wheels

Naturally, after two or three parallel folds have been made, it is hard to fold a large, bulky sheet in the opposite direction. Therefore, when right-angle folds are required, the sheet is generally scored with scoring wheels, which break the stock where the crease is to go. Work may be scored as it comes out of any of the folding units. Perforating and cutting blades may also be used at any of these points instead of scoring wheels. (See fig. 16-15.)

If more folds are necessary after the sheet leaves the second folding unit, it is run over another set of cross-carriers into a third folding unit. The sheet finally emerges from the folding



57.469X

Figure 16-15.—Scoring wheels may be located on either the upper or lower shafts, depending upon which way the sheet is folded.

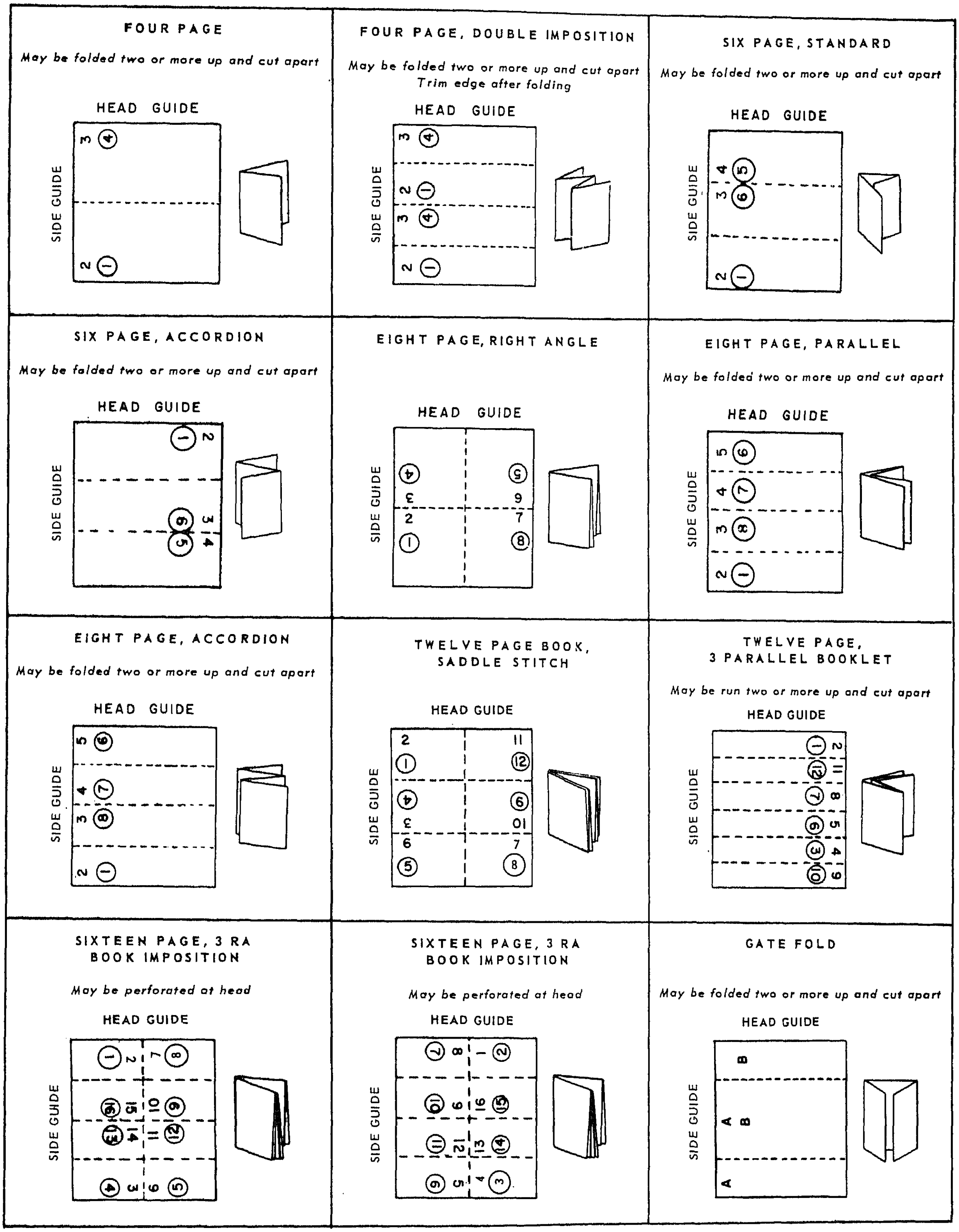
Stacker

On most folders, the stacker (delivery unit) is interchangeable with the cross-carrier sections. You can remove the cross-carrier and attach the stacker in its place at any point where no more folds are required. If the sheet requires only a single or parallel fold, the folder operator generally places the stacker after the first folding unit. If right-angle folds are necessary, the folder operator may place it after the second folding unit, and so on. Thus, the sheet does not have to travel through the entire machine when only simple folds are required.

Folding Impositions

The imposition, arrangement, or layout of the pages on the signature is highly important. It must be planned before the job is printed. The stripper should consult the personnel in the bindery before preparing the flats in order to avoid a slip-up that might necessitate time-consuming folding by hand.

The imposition must be planned so that the pages will be in their proper order after the signature is folded. The chart in figure 16-16 shows some of the different impositions that you may use for the folding machine. This chart is intended only as a guide, however, and you will find that many of these



FOUR PAGE
May be folded two or more up and cut apart

FOUR PAGE, DOUBLE IMPOSITION
May be folded two or more up and cut apart
Trim edge after folding

SIX PAGE, STANDARD
May be folded two or more up and cut apart

SIX PAGE, ACCORDION
May be folded two or more up and cut apart

EIGHT PAGE, RIGHT ANGLE

EIGHT PAGE, PARALLEL
May be folded two or more up and cut apart

EIGHT PAGE, ACCORDION
May be folded two or more up and cut apart

TWELVE PAGE BOOK,
SADDLE STITCH

TWELVE PAGE,
3 PARALLEL BOOKLET
May be run two or more up and cut apart

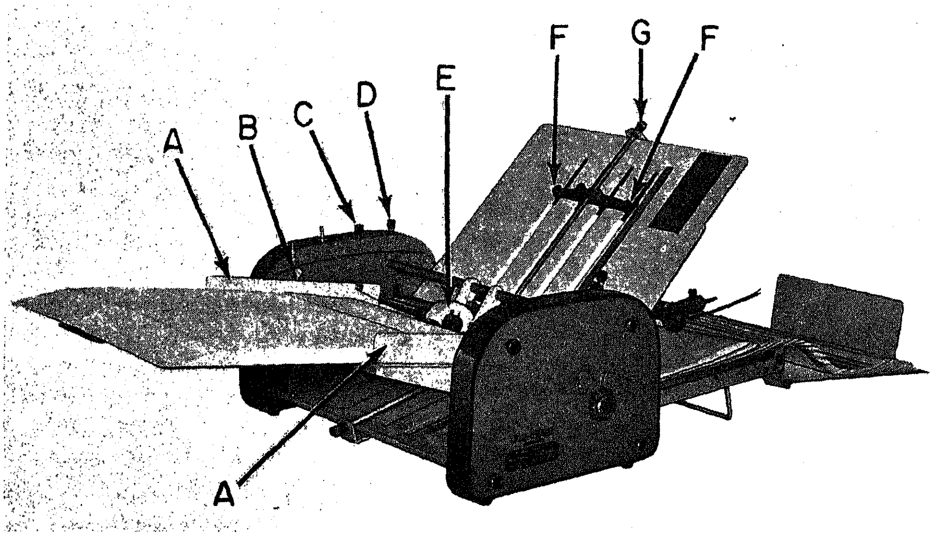
SIXTEEN PAGE, 3 RA
BOOK IMPOSITION
May be perforated at head

SIXTEEN PAGE, 3 RA
BOOK IMPOSITION
May be perforated at head

GATE FOLD
May be folded two or more up and cut apart

57.471X

Figure 16-16.—Folding impositions.



A. **Paper Guide (2)**
B. **Posts (2)**
C. **Feed Roller Adjusting Screw**
D. **First Metal Roller Adjusting Screw**
E. **Feed Cap**
F. **Fold Plate Adjusting Screws (2)**
G. **Minute Adjustment Knob for Fold Plate**

57.761X

Figure 16-17.—Tabletop folding machine.

TABLETOP FOLDING MACHINES

Shown in figure 16-17 is a 17- by 22-inch, tabletop folder that is similar in operation and setup to the smaller, compact folders you will find aboard ship. It is friction fed and can handle single or double parallel folds. It also can slit, score, or perforate the sheets by the addition of special attachments.

Feeder Setup

When loading stock on the paper platform, you can place a stack of approximately 50 sheets under the feed cap, or you can place a larger lift under the feed cap by fanning the stack so that the topmost sheets overhang the others and will be caught and fed into the machine one sheet at a time in the manner shown in figure 16-18. An extension bar is provided for use when the fanned stack is too long for the platform.

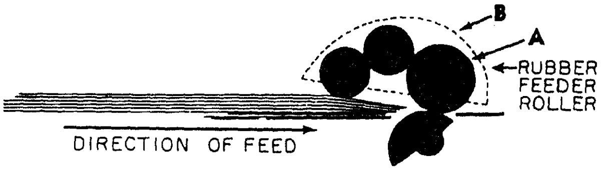
You should center the paper on the platform, loosen the posts (fig. 16-17), move the paper guides up against the edges of the paper pile, and then lock them in place.

The rubber feed roller, shown in figure 16-18,

than one sheet from being fed at a time into the machine. To set the rubber roller, you should raise the feed cap and slip a sheet of the stock to be folded underneath the roller. Then adjust the roller with the feed roller adjusting screw (fig. 16-17). A clockwise turn of the screw increases the pressure and, vice versa. Adjust the roller until the sheet is held in tack with a very slight pressure.

Fold Plates

The tabletop folding machine has two fold plates: an upper and a lower. The upper fold plate



A. **Rubber Feed Roller Which Acts As A Caliper for the Stock.**
B. **Feed Cap.**

57.664X

is longer than the lower one. If only one fold is required, you can turn the fold selector knob on the far side of the machine to prevent the paper from going into the lower fold plate. You can also remove the upper fold plate from the machine and place a no-fold deflector plate, shown in figure 16-19, in its place. When this is done, only the bottom fold plate will be in use. If you wish to run the paper through without folding it, as when you are perforating the sheets, place the deflector plate in the machine and turn the fold selector knob to prevent the paper from entering the lower fold plate.

To install the fold plates, you simply push them in along the slides provided until they catch and are held firm. To remove the fold plates, you should raise them slightly and then pull them out.

You can set the fold plates for the width of the fold by loosening the fold plate adjusting screws, shown in figure 16-17, and moving the fold plate stop manually until it is at the correct position on the scale provided on the front of the fold plate. The minute adjustment knob is for making minute adjustments. Most operators remove the bottom fold plate from the machine when setting it. On some machines, you can set the fold plate stop at a slight angle, if necessary, when the sheets are not cut true.

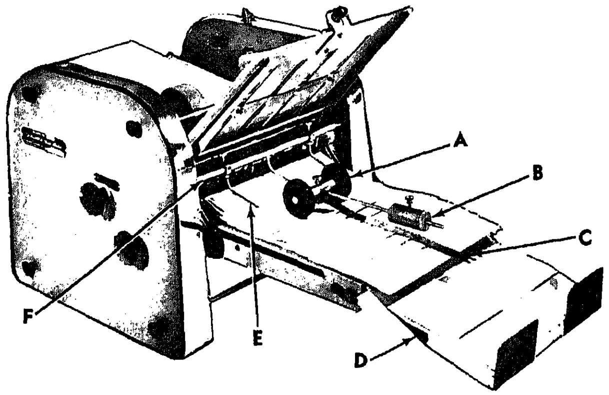
First Roller Pressure Adjustment

You can adjust tension on the first metal roller to accommodate stock of varying thicknesses or to cause one side of the paper to enter the first fold plate faster than the other, thus allowing for badly cut sheets.

No adjustment is necessary for most paper stocks, but for thin paper, which has a tendency to wrinkle, you should turn the first metal roller adjusting screw (fig. 16-17) clockwise to release the tension on the first roller. Turn the knobs in the opposite direction to accommodate heavy stock or extremely smooth coated stock.

57.667X

Figure 16-19.—No-fold deflector plate.



A. Stop wheels.
B. Counterweight.
C. Metal hold-down.
D. Receiving tray.
E. Paper depressor.
F. Paper stack support rod.

57.666X

Figure 16-20.—Stacker controls.

Stacker Controls

Figure 16-20 shows the stacker controls. As the folded sheets emerge from the machine, they are carried by two rubber conveyor belts under the stop wheels and finally out to a receiving tray where they are stacked until they can be removed from the machine.

You can move the stop wheels forward or backward along the rod to which they are attached. The stop wheels should be set to rest on the front edge of the folded sheet as it comes out of the folding unit. The counterweight can also be moved forward or backward for different types of stock. When you move it away from the folding unit, more pressure is created on the stop wheels, and vice versa. The receiving tray simply hooks onto the conveyor table. You can remove or install it easily.

The paper depressors should be adjusted to just clear the folded sheets as the paper emerges from the folding unit. You can remove the paper stack support rod to which these depressors are attached by pushing in on it at the near (operator) side of the machine. This will release the paper support rod at the far side, and you can then remove it from the folder.

The rubber transportation rollers should be moved sidewise as necessary to accommodate different widths of stock. They are held in place with setscrews. You should set them about 1/2 inch in from the edges of the sheet.

Scoring, Slitting, Perforating

When the folding machine is to be used to score, slit, or perforate, you must add special wheels to the upper and lower transportation axles. These axles are located at the back of the machine, in front of the receiving tray. Various wheel arrangements are shown in figure 16-21.

Removing the Transportation Axles

To remove the upper transportation axle when adding scoring wheels, slitters, or perforators, you should first raise it until the bearing lock snaps into place under the bronze bearing. Then loosen the setscrew and move the bushing out of the bearing toward the center of the machine. Push the entire shaft into the bearing, and you will find it simple to remove the shaft from the machine.

To add additional lower transportation rollers, slitting wheels, or perforating wheels to the lower transportation axle, you should remove the clip as shown in figure 16-22 and the tap out pins from the eccentrics. Loosen the setscrews in all transportation rollers or wheels. Push the axle to the right out of the side frame far enough to enable you to remove the eccentric rollers or gears. Do not push the axle entirely out of the machine. When you are replacing the eccentrics, be sure that their high sections are on opposite sides of the axle so that the forks on the conveyor table can be activated.

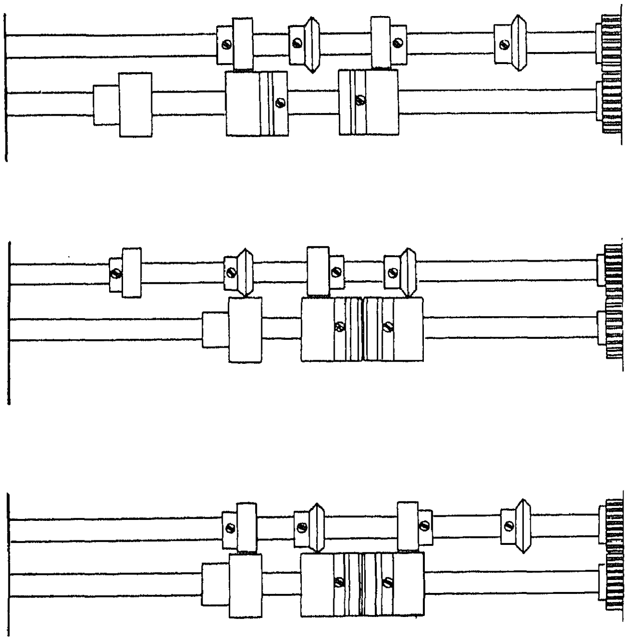


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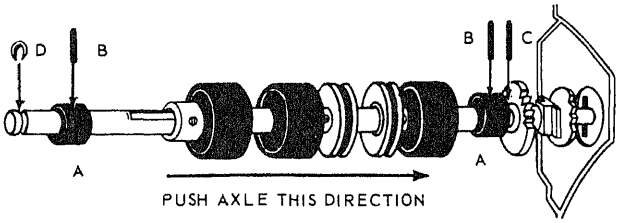
Figure 16-21.—Various wheels arrangements.



A. **Eccentrics.**
B. **Pin.**
C. **Pin.**
D. **Clip.**

57.673X

Figure 16-22.—Loosening the lower transportation axle.

GATHERING

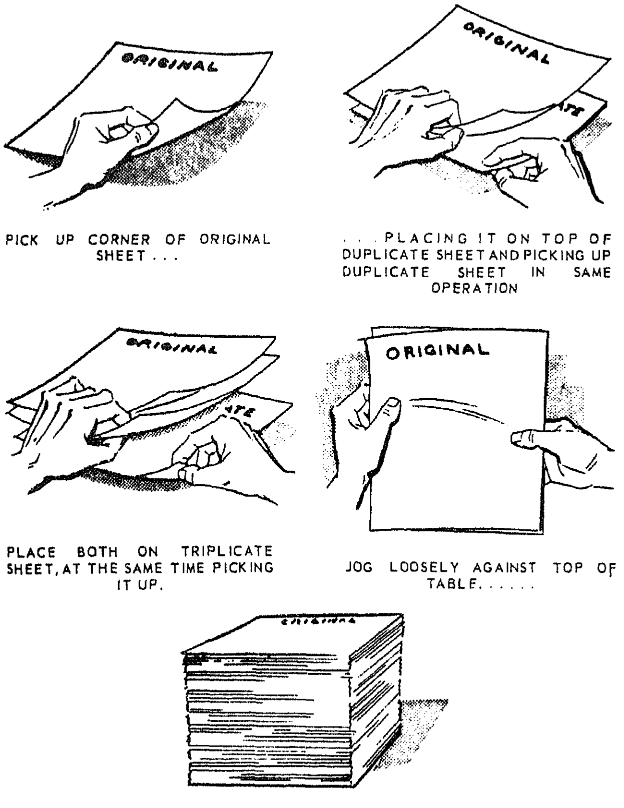
Before a multipage lithographic printing job can be bound, it may be necessary for you to assemble the pages in their correct sequence. This procedure is known as gathering or is sometimes referred to as collating. However, collating more correctly describes the process of checking gathered pages or signatures.

If the job is to be bound along the fold (saddle), the signatures must be inserted into one another in sequence. To gather folded signatures by hand, place the signatures in stacks on a table with the lowest numbered pages on the left. Then, starting at the right side, pick up the signature on the top of the first stack and insert it in the fold of the signature from the top of the stack next to it. Continue this operation, working to the left, until one signature has been taken from each stack. The completed units of assembled signatures are stacked in a crisscross pattern to keep them separated until they are bound (stapled or stitched.)

The procedure for assembling flat, unfolded sheets that are to be stitched along the edge is similar to the one just described except that the pages are placed one on top of another instead of being inserted one into the other. You may work from the right to the left in both cases, and you should always crisscross the gathered pages.

There are so many methods of gathering that it would be extremely difficult to describe them all. Some binderies are equipped with gathering racks, foot- and power-operated machines, and the time-tested method of picking up the sheets from the stacks as you walk around a table. You may also find a gathering machine connected directly to your lithographic offset press.

Many office forms are needed in duplicate or triplicate. Duplicate or triplicate forms are generally printed on different colors of stock and are frequently numbered. This means that the bindery operator must assemble the sheets in sets and in the proper sequence before they can be padded, stitched or punched. As shown in figure 16-23, these sheets are assembled in sets, in the same manner that you assemble loose pages for a book that are to be side stitched. You should then stack the sheets in a pile instead of crisscrossing them. When you have enough sets for a single pad or book (generally 25 sets of triplicate forms or 50 sets of duplicates), place a piece of chipboard on the bottom of the pile and continue working through the pile to the next pad or book. You should then place the chipboard at the ends of each pad. If forms are to be stapled or stitched instead of padded, the capacity of the stitching equipment will govern the number of sets that you can put in a book. In any case, you should try to work with multiples of 25 sets.



PICK UP CORNER OF ORIGINAL SHEET . . .

. . . PLACING IT ON TOP OF DUPLICATE SHEET AND PICKING UP DUPLICATE SHEET IN SAME OPERATION

PLACE BOTH ON TRIPLICATE SHEET, AT THE SAME TIME PICKING IT UP.

JOG LOOSELY AGAINST TOP OF TABLE. . . . . .

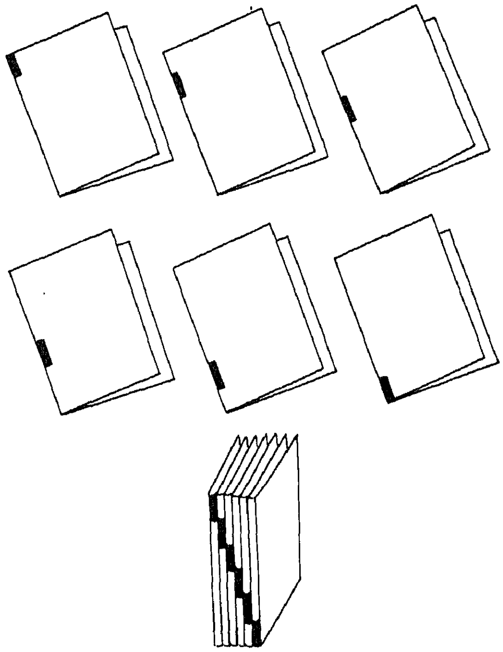
AND STACK IN AN EVEN PILE

57.476

Figure 16-23.—How to assemble triplicate forms.

COLLATING

The process of checking the assembled book to see that all signatures have been included and that they are in proper sequence is known as collating. In the case of small pamphlets this may amount to nothing more than going through the pages of the assembled booklet. In the case of larger publications, a collating mark is usually printed in the gutter of each signature in such a position that it will appear along the outside fold (backbone) of the folded signature. The collating mark is dropped a uniform distance on each succeeding signature, so that when all the signatures are gathered in the correct sequence, the collating marks will appear as a diagonal line down the spine of the book. This line enables you to tell at a glance whether the signatures are in the correct sequence. See figure 16-24.



57.473

Figure 16-24.—Collating marks printed along the spine of each signature.

Some shops print a numerical collating mark on the first page of each signature to aid in identifying and laying out the signature for gathering (fig. 16-25). Of course, you still must look at each page individually when collating the entire book.

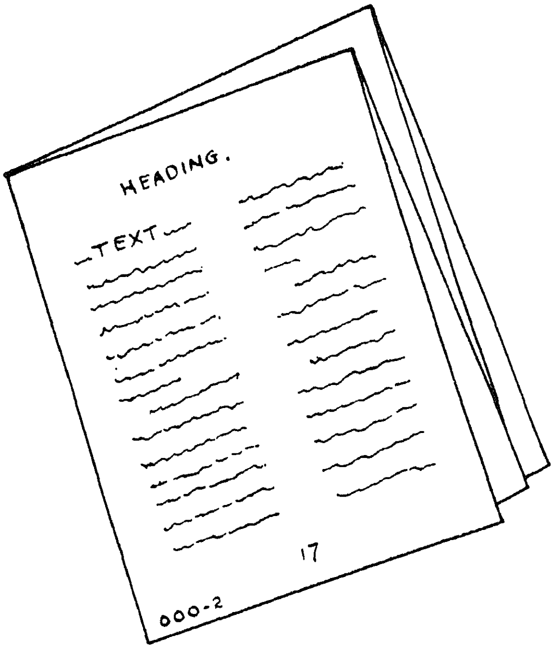
PADDING AND BINDING

After the job has been properly assembled and trimmed on the paper cutter, it is ready for padding and binding. (Sometimes it is bound before it is trimmed, but this procedure is optional.)

The type of binding done in the average printshop is not the same as that done in large binderies, which specialize in that kind of work. Bookbinding is an art in itself; therefore, it has no place in the small-job shop. However, almost all printshops do the simpler forms of binding, such as stapling small books and pamphlets and padding, which are standard operations in any small printshop.

PADDING

Padding is the process of making pads or tablets by cementing the edge of the stack of sheets. A pad generally consists of from 50 to 100 sheets of paper and a chipboard back. The paper is jogged as even as possible and is stacked on a table or in a padding press, like the one shown in figure 16-26. You must always clamp the sheets or weigh them down, as this will force their edges together to form a smooth surface for the padding cement.



57.474

Figure 16-25.—Numerical collating mark on the first page of a signature.

The padding cement is a water-soluble liquid with a thick, creamy texture. It can be applied to the edge of the paper with an ordinary paint brush, as shown in figure 16-26. It dries within a few hours to a flexible, rubbery substance that binds the pages together. One coat of cement is usually enough, but a second coating and even a third coating are sometimes applied to give the pad additional strength. Some operators add a piece of cheesecloth or thin gauze to the padded surface to ensure durability.

After the cement has dried, you can separate the pads by running a knife blade through the padded surface, just beneath each sheet of chipboard backing. This will give you a group of individual pads, each with a cardboard back.

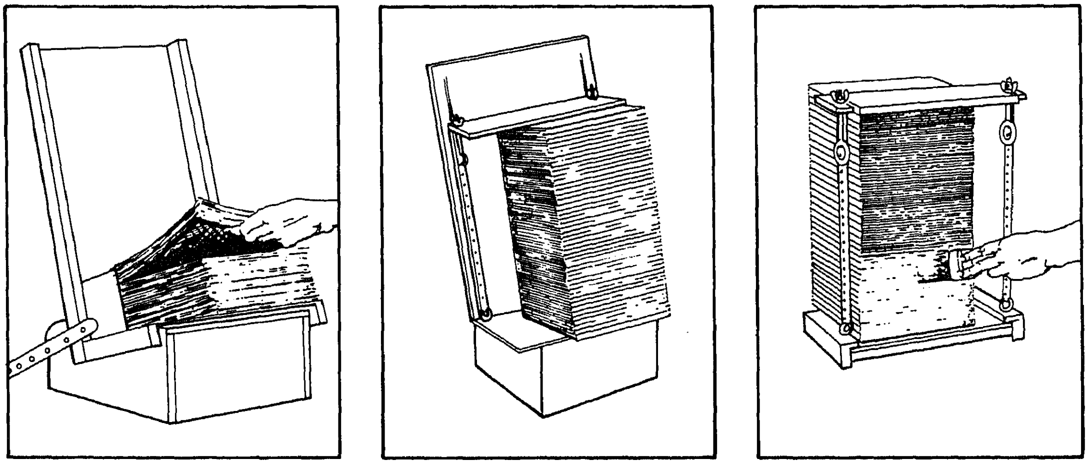
When you are not using the padding cement container, it should be kept tightly closed, as air will ruin it in a very short time. You should wash the paint brush out with warm, soapy water after each use to keep it from getting clogged beyond use.

STAPLING AND WIRE STITCHING

A common method of binding printed materials is to fasten them with staples. When the staples used are formed from a spool of thin wire instead of being preformed, the binding is referred to as wire stitching. Printed materials may be either saddle stapled along the fold or side stapled flat along the edge; both of these methods are shown in figure 16-27.

Staplers

You may use a foot-operated stapler, like the one shown in figure 16-28, for stapling small books and pamphlets. These staplers operate on the same principle as the ordinary hand-operated stapler. The staples come in strips, and they may be inserted into a magazine at the back of the machine. They are automatically pushed forward by a spring and are separated and driven through the paper by the plunger when you step on the foot pedal.



PLACE SIDE OF PAPER TO BE PADDED AGAINST THE BACK OF THE ALIGNMENT BOARD.

ATTACH TOP BOARD AND APPLY NECESSARY PRESSURE WITH WING NUTS SUPPLIED.

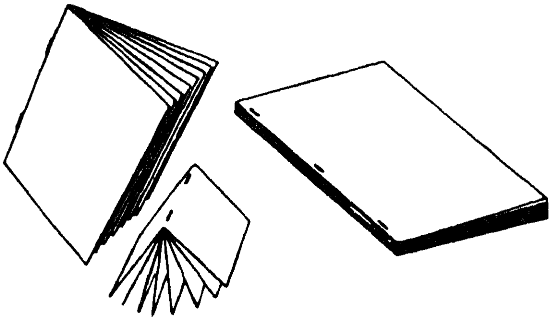
REMOVE PRESSURE UNIT FROM STACKING RACK AND APPLY PADDING CEMENT.

57.47

Figure 16-26.—Using a padding press.

To saddle staple a book, you simply open the book and place it so it straddles the stapler table (the housetop-shaped part below the stapler head). There are ordinarily no side guides on foot stapler tables. You just move the book to the approximate location where you want to staple it, then slide the book along until it is in position for the next staple. Two or three staples are sufficient for most booklets.

If the book is to be side stapled, you can release the catch underneath the stapler table and raise the table to a flat, horizontal position.

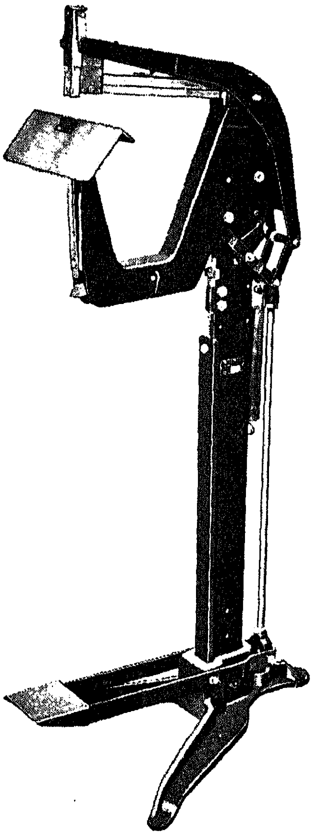


SADDLE STAPLED
BOOKS ARE STAPLED
ALONG THEIR FOLD

SIDE STAPLED
BOOKS ARE STAPLED
FLAT ALONG THE EDGE

57.478

Figure 16-27.—Two methods of stapling.



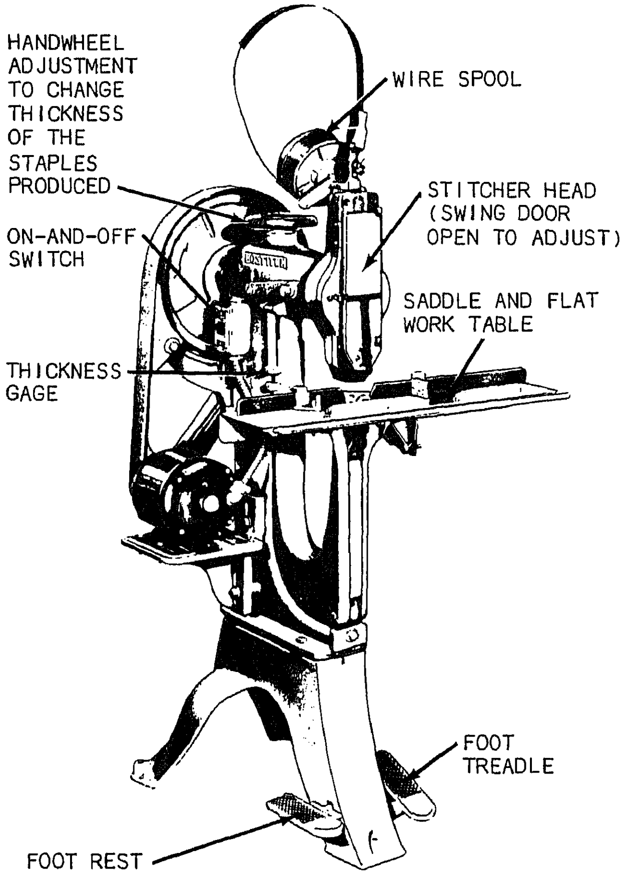
57.47

Figure 16-28.—Foot-operated stapler.

Wire Stitchers

The type of wire stitcher shown in figure 16-29 is more versatile than staplers and is used throughout the Navy. Wire stitchers are designed to handle either flat or saddle work in various thicknesses, from two sheets of paper to several hundred, depending on the type of use and thickness of the paper stock. Most wire stitchers use either flat or round wire. Flat wire is recommended for thicker and side stitched work.

As you operate a wire stitcher like the one shown in figure 16-29, the staples are formed from a spool of wire. The wire is threaded from the spool, down through the feeder mechanism, which automatically advances the wire and forms a new staple each time the foot treadle is pushed down. The length of the staples is adjusted for various thicknesses of work by turning the handwheel (fig. 16-29). To set the stitcher wire length, place a sample of the work in the thickness gauge and turn the handwheel until the sample is held firmly in the gauge. Next, turn the handwheel counterclockwise enough to allow you to remove the work sample. After the sample is removed, return the thickness gauge to the point where it firmly held the work sample. Refer to figure 16-30 for a comparison of properly and improperly formed staples. After you adjust the thickness gauge, check the appearance of the staples. If they do not look like the one shown at the top of figure 16-30, you should readjust the thickness gauge.


HANDWHEEL ADJUSTMENT TO CHANGE THICKNESS OF THE STAPLES PRODUCED
WIRE SPOOL
STITCHER HEAD (SWING DOOR OPEN TO ADJUST)
ON-AND-OFF SWITCH
SADDLE AND FLAT WORK TABLE
THICKNESS GAGE
FOOT TREADLE
FOOT REST

57.479X

Figure 16-29.—Wire stitcher.

The work table of the wire stitcher is adjustable for either flat or saddle work. It is equipped with adjustable guides and stops for accurate positioning of the staples in your work.

> **CAUTION**
>
> Do not touch the stitcher head when the power is on. This can injure your fingers. Always secure the power to the machine before putting your hands between the work table and the stitcher head.

In lithographic shops with large bindery sections and in shops that specialize in bindery

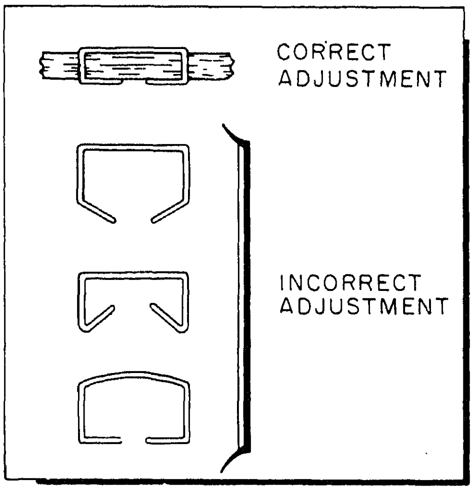


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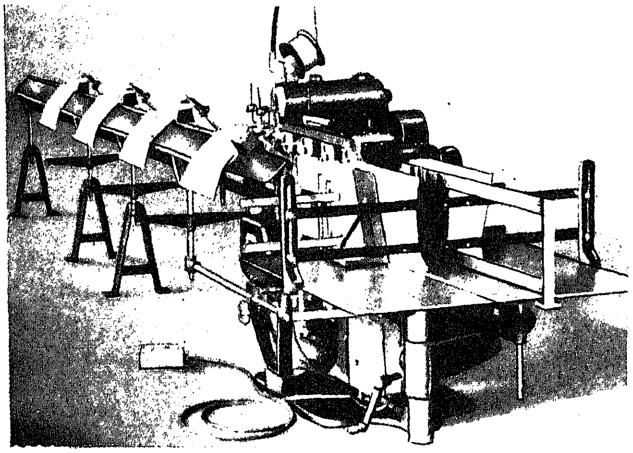
Figure 16-30.—Comparison of staples when the thickness gauge is properly and improperly adjusted.



57.480X

Figure 16-31.—A large automatic stitcher machine.

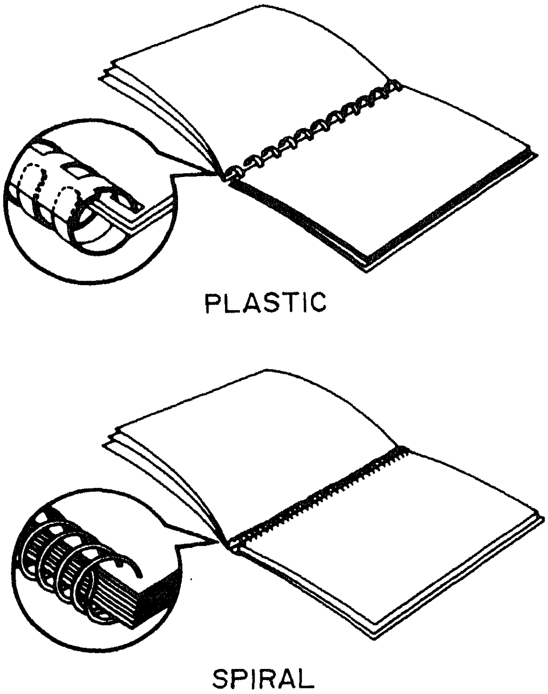
work, you may find stitching equipment similar to that shown in figure 16-31.

PLASTIC AND SPIRAL BINDING

As shown in figure 16-32, spiral binding and plastic binding are two types of widely used specialized binding. The spiral binding originated in Europe and requires the use of special bindery equipment. The job is printed and folded in the regular manner; then it is trimmed on all four sides and is punched. The wire, which is already in spiral form, is inserted by hand or by a machine and is bent at each end so that it will stay in place.

The plastic binding is a very popular type of binding and is available in a variety of colors. You have probably seen it used on literature and brochures. After the job is run and folded, the paper is trimmed on four sides. Then a series of rectangular holes is punched in the paper along the edge to be bound. Next a roll of comblike plastic is stretched open and inserted into the holes.

The application of special bindings, such as the two just described, is not a part of every Navy lithographic shop. However, it can be done if your bindery is equipped to handle it.

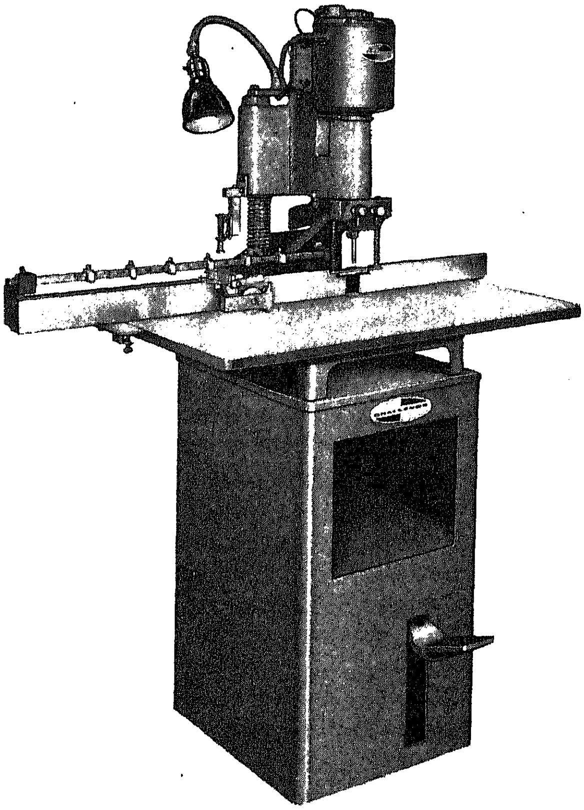


57.483

Figure 16-32.—Two types of specialized binding.

PAPER DRILL AND PUNCH

Many lithographic shops are equipped with a paper drill similar to the one shown in figure 16-33. This type of drill is relatively easy to



57.486X

Figure 16-33.—Paper drill.

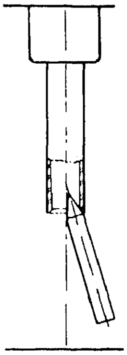
operate. When you depress the foot treadle to bring a hollow, rotating drill bit down through the stack of paper, holes are drilled in the paper. A guide bar with adjustable stops is located on the drill table to space the holes accurately.

In addition to being used to make conventional round holes, drills can also be used to corner cut or to place V-slots or slits in the paper. Of course, to do these operations you must use special attachments. If brown burn spots appear on the top sheets of paper when you drill through them, this means that the drill bit is dull and needs to be sharpened. To sharpen a drill, you hold an abrasive pencil against the rotating drill as shown in figure 16-34. You should apply a wax to the drill bit to reduce friction as it passes through the paper. Standard drill bit sizes are shown in figure 16-35.

Jobs that are to be bound in looseleaf binders are generally punched or drilled. This type of work is done on hand- or foot-operated punches or on drilling machines. Special dies are available for producing the many unusual shapes required for various punching jobs.

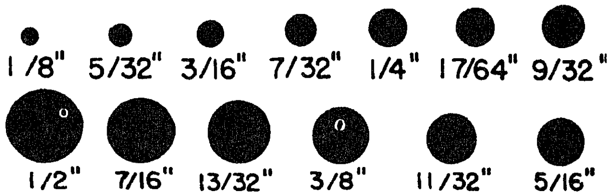
Once you make a few preliminary adjustments, the hand- and foot-operated punching machines are similar in operation.

You can move the punching dies sidewise on the punching machine until they reach the required positions for the holes; then lock them in place. Next, set the paper guide on the left end of the machine to establish the proper location for your paper. The paper can then be inserted into the machine a few sheets at a time, and you can punch the sheets by lowering a hand lever or by stepping on a foot treadle.



57.489X

Figure 16-34.—Paper drill bits may be sharpened by holding the abrasive pencil at a slight angle. Rotate the pencil in fingers to provide a fresh surface to the drill.



57.490

Figure 16-35.—Standard drill bit sizes (shown slightly reduced).

WRAPPING AND PACKING

Letterheads and loose office forms are generally packaged in lots of 500 sheets unless otherwise specified.

Although wrapping paper comes in rolls of various widths, 24- or 36-inch widths are best for wrapping purposes. Tear off a sheet about double the length of the job to be wrapped. Wrap the paper around the width of the printed sheets and fasten it in place with a piece of tape. Tuck in the ends, turn the top flap down and the bottom flap up, and then tape across them with a long strip of the tape. Turn the package and repeat this process at the other end.

Loose cards, in lots of 100 or 200, should be wrapped with bands to prevent the stack from falling apart in the package. Cut a narrow band from a piece of wrapping paper. Wrap it around the cards and fasten it with a piece of tape. After all cards have been banded, wrap them in a package. When envelopes and cards come in boxes, lithographers do not wrap the boxes. They simply replace them in the box and tie the box with a piece of string.

Pads or books may be wrapped in lots of 5 to 10 per package, depending on their size. Packages containing any printed material should be marked in some way so that you can tell what is inside without opening the package. You should attach one of the printed sheets to the outside of each package to show its contents.

SAFETY IN THE BINDERY

Accidents are caused; they don't just happen! Safety first isn't just another slogan when it comes to operating bindery equipment. There are several safety measures you must observe whenever you are operating any type of equipment.

- Never operate any equipment unless you are thoroughly familiar with its controls and operating procedures. When in doubt, check the manufacturer's instruction manual or get assistance from a qualified operator.

- Use all built-in safety features and guards on the equipment you are operating. Don't remove side plates or covers and leave them off to make it easier to clear a paper jam when it occurs. Never attempt to cheat a safety device.

- Never attempt to clear a jammed machine unless you have secured (disconnected) the power first.

- Check your clothing for loose, dangling ends before operating the equipment. Don't use long rags that can easily become tangled in moving parts. Keep tools such as screwdrivers, rulers, and small wrenches away from the operating equipment.

- Never lubricate running machinery. Turn off all equipment before you oil it.

- Operate electrical equipment only if it has been properly safety checked and tested. Don't attempt to make electrical repairs yourself, call an electrician.

- Practice good housekeeping. Don't let paper or other materials pile up around machinery. Use waste receptacles.

- Keep your mind on your job. Many bindery operations are boring and tedious and you may let your guard down; a smashed or missing finger could result from a few moments of inattention.

- Call attention to any unsafe work practice. No one willingly wants an accident to occur, but people usually aren't aware that what they are doing is unsafe. Remember—better safe than sorry!

SUMMARY

As a Navy Lithographer, you will find that the bindery section of your shop is where you will perform the last step in almost all of your printing jobs. In the bindery, you will cut your final press sheets, staple, stitch, fold, gather, collate, pad, drill, and then wrap them for delivery to the person who requested the job. Up to this point, a lot of work has gone into the printing job, from planning through production. To complete the printing job, you must have a good knowledge of the bindery equipment to be used and the steps you need to take.

The most widely used pieces of bindery equipment are the hand- and power-operated paper cutters. On the hand-operated paper cutters, the operator has to manually lower the blade through the stack of paper stock while the same action is performed automatically on the power-operated paper cutters.

The distance between the blade of the knife and the paper cutters back gauge determines the measurement of the cut. Once you make this distance setting and jog your printing job into the cutter and against the back gauge, you are then ready to cut (trim) the job. Next, you should lower the clamp and the blade of the knife into the stock to make the cut. There are, of course, other cuts to be made; you will need to reset the back gauge, turn the job, and then make the rest of the cuts.

Press sheets may be cut from stock sheets that will be run on your offset press. To do this, you should calculate the cuts to be made so that you will get the most press sheets out of the stock sheets. Also, you should figure out which cuts will be made first and the order in which the rest of the cuts will be made. This is necessary because cuts made in the wrong order could cut into the areas of press sheets that you plan to use for your pressrun.

Just as care of all other equipment in your lithographic shop is important, care of the paper cutter is also important. The cutter knife blade must be changed and sharpened when it becomes dull or damaged. Also, you must watch carefully to see if the blade ever starts creeping down. If it does, this movement indicates that there is a problem with the clutch mechanism, and you will need to make adjustments to the clutch mechanism.

Folding machines used in your bindery may vary in size. Each machine will perform basically the same operations. However, on most of them you can also add attachments to trim, perforate, score, and even paste sheets of paper. You may be using one of the two basic types of folders—knife folders or buckle folders—with either continuous or pile feeders.

Some folders are so small they can fit on a tabletop. However, they can still take a 17- by 22-inch sheet of paper. These folders may be set up easily for more than one fold. And they, can slit, score, or perforate sheets when you add special wheels to the upper and lower transportation axles.

Collating is a term sometimes misused by printers because they have a tendency to use the words gathering and collating interchangeably.

Gathering is the process used to put a booklet or book together from your printed sheets or from the cut (or trimmed) press sheets. This operation may be accomplished by hand. When the sheets are to be gathered by hand, the pages are laid out in page order, and you have only to pick up one sheet at a time from each stack. When you finish the booklets, they are stacked in a crisscrossed pattern and are later stapled or stitched.

Gathering may also be required even for office forms that need to be completed in duplicate or triplicate. After gathering these forms into sets of two or three copies, the sets must then be gathered into pads of from 25 to 50 sets. Then a backing sheet is added to the sets and they are padded together.

Collating, however, is the process of checking the page sequence of an assembled book to ensure that it contains all of the required signatures. To help you check the signatures in the book quickly, some lithographers print collating marks in the gutter at descending points on each signature. After these signatures are gathered and collated, you can look for these marks to make sure the signatures are arranged in the proper order. At a glance you can tell if all of the signatures are present and in proper order. Of course, you still must sight each page to complete your collating job.

Some of your work in the bindery will consist of binding individual sheets together by padding them, either before or after the sheets are trimmed. Padding is accomplished by first stacking the sheets, either on a table or in a padding press. The stack should present a smooth surface where the padding cement will be applied. Then, the stack is weighted or clamped, and the water-soluble, liquid padding cement is applied to the stack of paper with a paint brush. The padding cement dries to a flexible, rubbery substance that binds the sheets together in a few hours.

Binding of individual sheets or signatures is sometimes accomplished with the use of staplers. The Lithographer uses a foot-operated power stapler which is much larger than a desk-type stapler; however, both operate on basically the same principle.

Another machine that you may use to produce staples and bind pages or signatures in the bindery is a wire stitcher. A wire stitcher produces staples from a spool of either round or flat wire. As the foot treadle is pushed down, the wire moves through the machine, making and inserting the staple in your job. The length (size) of each staple is determined by a machine setting you have made. Therefore, the staples produced are the right size for the size of each job you need them for.

You will need special bindery equipment if you are required to do spiral binding. After you have punched the line of small holes on the binding edge of your job, the wire, which is already in spiral form, is inserted by hand into the holes and is bent at each end to keep it in place.

Plastic binding is somewhat like spiral binding. However, with plastic binding the series of holes in your work are rectangular and the plastic binding material is comblike. You will need to stretch the comblike rectangular teeth open and insert them into the holes. Plastic bindings come in a variety of colors.

You may be required to drill or punch holes in the binding edge of a stack of paper in your bindery. To do this, you may use a paper drill. Holes are drilled using changeable hollow bits that drill through the paper as the foot treadle is depressed and the hand lever is pulled down. These drill bits come in several diameters. The process of drilling the holes in paper is called either punching or drilling. This is true whether the machine is hand- or foot-operated.

The last step in the bindery is wrapping and packaging the job for delivery to the person who requested the work. Many jobs are wrapped in brown paper to completely cover the job, while loose cards, in stacks of 100 or 200, may be wrapped with just a narrow band of wrapping paper to keep them from falling apart.

In any case, you should wrap the package so that a person can tell what is in it without opening it. You can do this by taping a sample of the work to the outside of your package.

There are safety measures you must observe while working in the bindery. Remember, accidents are caused; they just don't happen! You should always be aware of anything that could be dangerous to you, to others, or to the equipment.

The administration of reproduction will be discussed in the next chapter.

CHAPTER 17

ADMINISTRATION OF REPRODUCTION

Designated sections of this chapter contain information required only for LI1 and LIC candidates. The section titles will be followed by parentheses enclosing the paygrade to which that section applies. LI3 and LI2 candidates DO NOT have to read these designated sections. However, junior LIs serving as LPOs may find the information of interest.

Duty assignments for Lithographers are varied. They range from the large plant ashore to a one- or two-man shop aboard ship. So naturally your duties and responsibilities as a Lithographer at various duty stations will also vary.

SHOP ADMINISTRATION

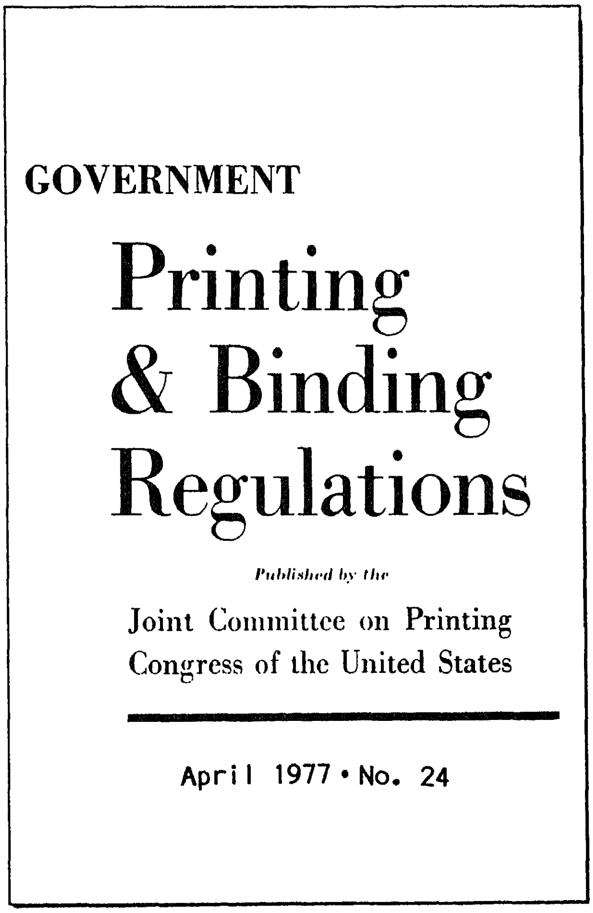
At the large shore plant the duties of administration and management normally are assumed by a senior petty officer or a CPO. You will be assigned to a specific work area, such as the pressroom or the darkroom. But if you are stationed aboard ship or on shore duty where the print shop is relatively small, you may be the leading Lithographer. The shop administration duties will then be your responsibility.

It is impossible to cover all the information which you will need to know to perform the duties of a leading Lithographer in this chapter. However, by studying the material presented here, you should develop a broad understanding of what is required to organize and manage a Navy lithographic shop effectively.

RULES AND REGULATIONS (E-6)

The basic rules and regulations covering all printing in the federal government are formulated by the Joint Committee on Printing (JCP). This congressional committee is composed of three members of the Senate and three members of the House of Representatives. It deals with all areas of government printing and periodically reviews and revises its regulations as technological advances within the trade occur and government policy changes. The committee's regulations are issued in a booklet called *Government Printing and Binding Regulations.* (See fig. 17-1.)

Since the JCP Regulations pertain to all government printing, they do not reflect certain



GOVERNMENT

Printing

& Binding

Regulations

Published by the

Joint Committee on Printing

Congress of the United States

April 1977 • No. 24

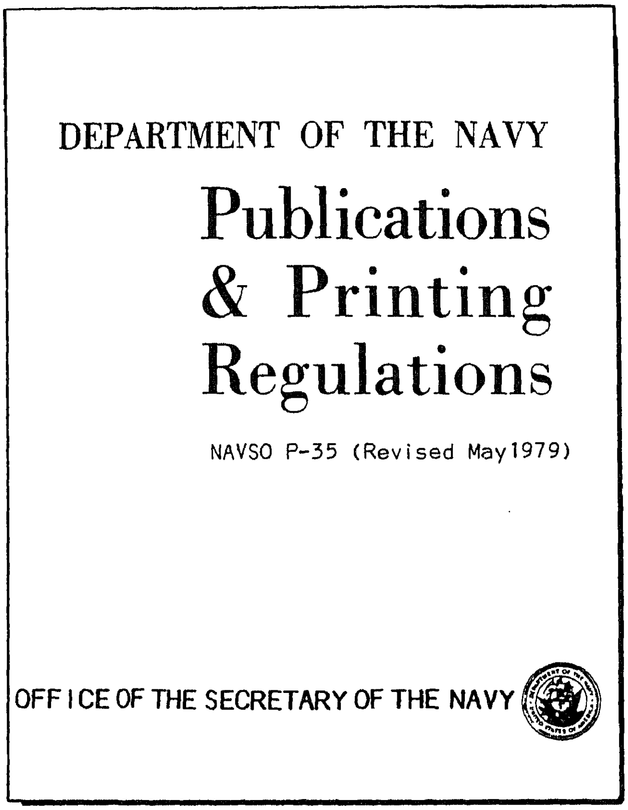
57.764

Figure 17-1.—Government Printing and Binding Regulations.

specific policies and regulations peculiar to the Navy. For this reason the Navy publishes another set of regulations titled *Department of the Navy Publications and Printing Regulations*, NAVSO P-35 (fig. 17-2). Such matters as the establishment of printing facilities, equipment procurement, the purchase of printing through commercial sources, and ship or station newspapers are covered by these regulations. Changes and revisions are periodically issued by the administrative assistant of the Secretary of the Navy's office.

NAVAL PUBLICATIONS AND PRINTING SERVICE (E-6)

As set forth in *Department of the Navy Publications and Printing Regulations*, NAVSO P-35, the Navy Publications and Printing Service (NPPS) exercises technical direction over the Navy's printing facilities, including those aboard ship.



DEPARTMENT OF THE NAVY

Publications
& Printing
Regulations

NAVSO P-35 (Revised May1979)

OFFICE OF THE SECRETARY OF THE NAVY

57.765

Figure 17-2.—Department of the Navy Publications and

As part of its shipboard lithographic shop program, NPPS assists the fleet in such matters as the following:

1. The establishment or disestablishment of shipboard printing plants
2. The addition or deletion of equipment on allowance lists
3. The replacement or disposal of obsolete and unrepairable equipment
4. Providing recommendations as to the design of new, and modernization of old, lithographic shops aboard ship

Another service available through branch offices of the Navy Publications and Printing Service is the informal training of Navy Lithographers on specific equipment or procedures. Arrangements for training can be made by contacting the director of the NPPS organization in your area.

The Navy Publications and Printing Service (NPPS) exercises control over lithographic equipment on board ships and in advance base functional components in conjunction with the Chief of Naval Operations and the Commander, Naval Ships Systems Command.

NAVSUPINST 5600.16 covers shipboard lithographic shop operations and the continuing responsibility for them.

NPPS provides services through the chain of command to fill requests for such things as on-the-ship survey of equipment and shop layout. These services are available at no expense to the ship. They should be requested, through channels, about a year before yard periods. NPPS also has a technical force available for the repair of equipment. This force will travel anywhere on a reimbursable basis.

PERTINENT PUBLICATIONS (E-7)

The basic rules and regulations covering all government printing are formulated by the Congressional Joint Committee on Printing. This permanent committee, sometimes referred to as the JCP, is composed of three Senators and three members of the House of Representatives. It deals with all problems relating to government printing, and it reviews and revises the regulations as technological advances and changes in government policy occur.

The Joint Committee on Printing (JCP) issues a booklet called *Government Printing and Binding Regulations* (also known as the *JCP Regulations*).

Since the *JCP Regulations* pertains to printing in all government agencies, it does not reflect certain specific regulations and policies which are peculiar to the Navy. For this reason, the Navy must make additional rules to supplement those provided by the JCP. Responsible offices and bureaus of the Department of the Navy interpret JCP policy and implement it with instructions, notices, and publications.

The Navy's publication entitled *Department of the Navy Publications and Printing Regulations*, NAVSO P-35 (revised), is available to all ships and stations. This pamphlet contains regulations covering ship and station newspapers, and other printed matter, such as books, blankbooks, manuals, pamphlets, folders, charts, posters, reprints, and copyrighted materials.

Navy Stock List of Forms and Publications, Cognizance Symbol I, NAVSUP 2002, lists all printed material in the Navy Supply System which is available for procurement through regular supply channels, and the pamphlet *Guide to Forms Management*, OAINST 5213.31 (*Navy Forms Manual*), is useful as a guide in the designing and preparation of new forms. The *Government Paper Specification Standards* establishes specification standards of paper for printing and binding for the U.S. government.

You will find regulations covering the handling and custody of classified material in the *Department of the Navy Information Security Program Regulation*, OPNAVINST 5510.1.

INSTRUCTIONS AND NOTICES (E-7)

Navy instructions and notices which pertain directly to printing are numbered in the 5600 series. These directives are usually one to four pages long and are included in the Navy Directives System. They supply all test information regarding printing rules and regulations. Since the ship's copy is usually retained in the ship's central files after routing, you should make arrangements to copy those pertaining to your work as they are routed to you.

It is up to you to be aware of all pertinent notices and instructions. The *Consolidated Subject Index of Unclassified Instructions*, NAVPUBINST 5215.4, contains an alphabetical listing of instructions. You should check through this index and its supplements at regular intervals and order any pertinent instructions that have not been received by your command.

You should establish a small library dealing with lithographic supplies and equipment in your shop or quarters. You may begin such a library with one or two good books on printing and a few manufacturers' instruction manuals. You can also add books on such related subjects as paper, ink, type, and so on.

Allowance lists and supply catalogs are also useful. So are catalogs and advertising literature from commercial firms. They will provide you with valuable instructional material. You can obtain advertising literature by writing to the manufacturers of the equipment or by dropping in to see their local representatives. You can obtain technical publications of the Navy through your education officer or division officer.

Lend your books to the people who work with you and encourage them to lend their books to each other. The more a person knows about the job, the more useful that person is to the shop and to the Navy.

TYPES OF UNLAWFUL PRINTING (E-7)

The laws of the United States place restrictions on printing, duplicating or reproduction of paper money, postage and revenue stamps, obligations, and securities of the United States and foreign governments, and of certain licenses, certificates, copyrighted materials, and other official documents. In general, the following items should not be copied or reproduced:

1. Paper money
2. Securities including certificates of indebtedness, bonds, and bank notes
3. Foreign currency
4. Any other monetary instrument
5. Postage stamps
6. Citizenship certificates
7. Bills of lading
8. Identification papers, such as driver's licenses, and so forth
9. Copyrighted materials (unless the copyright owner has given permission in writing for his materials to be reproduced)
10. Indecent or obscene materials

Federal laws also provide severe penalties for the importing, transporting, mailing, circulating, or production of indecent or obscene materials.

COUNTERFEITING AND FRAUD

The federal laws designed to prevent counterfeiting and fraud are found in Title 18 of the reproduction of bonds, paper money, coins and metals issued as money, postage stamps, and other obligations or securities of the United States and those of foreign governments. The laws provide, however, that these items may be reproduced as illustrations for articles, books, albums, journals, newspapers, and films having a news, historical, collector's, or educational purpose. Such reproductions must be printed in black and white only (except for film). Postage stamps may be reproduced the same size, but illustrations of paper money, bonds, and so on, must be reduced to 3/4 or enlarged to more than 1 1/2 times the original size. No individual facsimiles are permitted. Severe penalties are provided for violations of these laws.

COPYRIGHTED MATERIALS (E-7)

In general, a copyright is the property right covering literary works (works expressed in words or numbers); musical works; dramatic works; audiovisual works (including motion pictures); sound recordings; and pictorial, graphic, and sculptural works.

Copyrights normally are for the life of the author plus 50 years, or 75 years from first publication if the author cannot be identified. Works prepared by employees of the U.S. government as part of their official duties are not, however, copyrightable. Government publications are generally within the public domain. However, some of them may contain copyrighted materials. For example, in this manual, you will find that some of the illustrations are reprinted with permission from copyrighted sources. (See the credit list in the front of the book.)

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Paraphrasing and word-for-word copying constitute copyright infringement. Adhering to certain specific features and treatment, order, key words, occasional whole sentences, and artist's interpretation and design also constitute infringement.

Infringement is punishable at law by award to the copyright owner of either the actual damages or statutory damages in an amount of each violation.

Copyright Infringement

As a general proposition, copyrighted works may not be used without permission of the copyright owner. Unauthorized use is copyright infringement, unless the particular use is outside the rights of use granted to the copyright owner by the law, or unless covered by one of many complex and narrow exceptions provided by the copyright law. An infringing user is liable for monetary damages, and the U.S. government has no general exemption for copyright infringement liability. Government employees are not, however, personally liable for copyright infringement occurring in the performance of their official duties.

Copyright Notice

Publicly distributed copies of published copyrighted works should bear a copyright notice consisting of three elements: (1) the letter *C* in a circle ("P" in a circle if a phonorecord of a copyrighted sound recording) or the word *Copyright* or the abbreviation "Copr."; (2) the year of first publication in some instances; and (3) an identification of the owner. It is a criminal offense to remove or alter any notice of copyright appearing on a copy of a copyrighted work with fraudulent intent. Although the presence or absence of a copyright notice does not conclusively establish whether or not a work is covered by a valid copyright, its presence does suggest that a prospective user should inquire further before using such work, without permission, in a way that might infringe the copyright owner's rights. Its absence may normally be relied upon as indicative that no copyright exists, unless there is actual knowledge that the work has not been published or that the copyright notice has been omitted without the authority of the copyright owner.

Copyright Advice

Questions as to whether a particular work is protected by copyright or whether a particular use would be infringement of copyright, as well as all other questions related to copyright, should be referred to Navy Patent Counsel or the Patent Counsel for the Navy in the Office of Naval Research.

Initial Action by Requesting Activities

When a Department of the Navy activity concludes that permission of a copyright owner may be required before use of a copyrighted work, the activity will request the permission directly from the copyright owner or agent and may pay permission fees of $500 or less. Copyright owners will often grant the Department of the Navy permission to make limited use of copyright material without charge. Unless the requesting activity is aware that free permission will not be granted, the initial request should ask for free permission. Copyright permission request and fee payments must be according to ONRINST 5870.5. Additional guidance on copyrighted materials used in Department of Navy publications is provided by NAVPUBINST 5870.1.

Guidelines for Permission Requests

Requests for free permissions should be constructed to permit an easy affirmative response using these guidelines.

1. The following information should be included in the request, if applicable and available:
   a. Complete identification of the material for which permission to use is requested, including title of the work, name of author, exact copyright notice(s) appearing on the work, and, when appropriate, editor and edition.
   b. Designation of exact portion of the work to be used (e.g., amount, page numbers, chapters, etc.). The Association of American Publishers and the Authors League of America recommend inclusion of a photocopy of the material to be used and the copyright page, if possible. Blanket permission to use excerpts "as later determined" will not be requested.
   c. Statement of intended use(s) of the material including, when appropriate, number of copies or phonorecords to be made, type of reproduction (photocopy, offset, typeset, tape, disk, etc.), intended distribution (including form and recipients). Also, whether the material is to be sold and contemplated fees or charges in connection with use or distribution of the material, length of time material will be used; and dates, media, and intended audience of public performances or displays.
   d. Contemplated modifications of the work, if any.
2. The request will be for no greater rights than are actually needed.
3. The request will be submitted in duplicate so that the recipient may retain one copy and return the other granting the requested permission.
4. The request will indicate that the copyright owner may designate the copyright notice and credit line to be used.
5. A self-addressed return envelope will be enclosed.

Purchase of Permission

Upon receipt of the response from the copyright owner or his/her agent, the requesting activity will review the response and determine whether the permission offered, if any, is of sufficient scope to cover the intended use and whether the use warrants the fee asked, if any. The requesting activity is authorized to purchase the permission offered if the fee does not exceed $500. If the fee asked exceeds this amount and purchase is desired, the matter should be referred with an appropriate citation of available funds to the Chief of Naval Research (Director, Navy Patent Program) for action.

Use Without Permission

In the event that a copyright owner cannot be located, or refused to reply or to grant a requested permission, or an offered permission is of doubtful scope to cover the intended use, or the fee asked is considered unreasonable, the activity should consult Navy Patent Counsel to confirm whether the material is covered by a valid copyright and for advice as to the risk of copyright infringement in the contemplated use. After consultation with Patent Counsel, the activity will make its final decision on whether to use the material, as contemplated, without permission. The using activity will be responsible for providin funds to answer any administrative claim fo copyright infringement.

Administrative Claims

Any communication on behalf of a copyright owner which directly or indirectly asserts a copyright infringement claim should be reported to the Chief of Naval Research (Director, Navy Patent Program) who is responsible for the adjudication of administrative claims against the Department of the Navy for copyright infringement.

HANDLING CLASSIFIED MATERIAL (E-7)

A Navy lithographic shop handles material which must be safeguarded according to security regulations. This material would be invaluable to an enemy or foreign government if they could gain access to it.

The responsibility of safeguarding classified materials may fall on any Lithographer at any time. For this reason, before a person is assigned to the lithographic shop, their background and past are thoroughly investigated by the Office of Naval Intelligence.

The classification and security of printing within the Navy are according to the *Department of the Navy Information and Personnel Security Program Regulation*, OPNAVINST 5510.1. It must be remembered that there is no adequate substitute for continuous day-to-day security consciousness in the proper handling of classified material.

Access to classified material is not automatically granted because a person has the proper clearances, holds a particular billet, or is senior in authority. Only if the criteria of proper clearance and "need to know" are both met should a person be given access to classified material.

NEED TO KNOW is the term given to the requirement that the dissemination of classified information be limited strictly to those persons whose official duties require knowledge of or possession. Responsibility for determining whether a person's duties require that they possess or have access to classified information and whether they are authorized to receive it rests upon each individual who has possession, knowledge, or command control of the information involved and not upon the prospective recipient. This principle is applicable whether the prospective recipient is an individual, a command, a defense contractor, another federal agency, or a foreign government. A "need to know" is recognized as established where ALL the following conditions exist: (1) the disclosure is necessary in the interest of national defense; (2) there clearly appears from the position, status, duties, and responsibilities of the applicant that he/she has a legitimate requirement for access to the classified information in order to carry out his/her assigned duties and responsibilities; (3) there is no other equal or ready source of the same classified information available; and (4) the applicant is or can be appropriately cleared for access to the degree of classified information involved and is capable both physically and mentally of providing the degree of protection which that information requires.

Purpose of the Security Program

The security program deals basically with the safeguarding of information that should not be allowed to fall into the hands of foreign governments or foreign nationals because of the danger that such information might be used to the detriment of the United States.

Information may be compromised through careless talk, improper handling of classified material, and in various other ways.

Security Principles

The Department of Defense security formula is based on the premise of circulation control; i.e., the control of dissemination of classified information. According to this policy, knowledge of possession of classified security information is permitted only to persons whose official duties require access in the interest of promoting national security and only if they are determined to be trustworthy.

Classification Categories

Official information which requires protection in the interest of national defense is limited to one of three categories: Top Secret, Secret, or Confidential. No information may be withheld or classified, if otherwise releasable, simply because such information might reveal an error or inefficiency or might be embarrassing. The person who requests the printing job to be accomplished is responsible for placing the proper classification on the work. It is the LI's responsibility to see that the proper classification is recorded on the job order, the negative preserver, and the negative log.

TOP SECRET.—The use of the classification Top Secret is limited to defense information or material which requires the highest degree of protection. Top Secret is applied only to that information or material, the defense aspect of which is paramount and the unauthorized disclosure of which could result in EXCEPTIONALLY GRAVE DAMAGE to the national security, such as the following:

1. Information leading to a break in diplomatic relations, armed attack on the United States or its allies, or war
2. The compromise of military plans or scientific or technological developments vital to the national defense

SECRET.—The use of the Secret classification is limited to defense information or material, the unauthorized disclosure of which could result in SERIOUS DAMAGE to the national security, such as the following:

1. Jeopardizing the international relations of the United States
2. Endangering the effectiveness of a program or policy vital to the national defense
3. Compromising important military or defense plans or scientific or technological developments important to national defense
4. Revealing important intelligence operations

CONFIDENTIAL.—Information or material classified Confidential is placed in the category whose unauthorized disclosure could reasonably be expected to CAUSE DAMAGE to the national security.

If it is desired to understand more thoroughly the various categories of classified matter, the Security Manual has a number of examples in each category. However, the most important thing to be learned at this time is that each category represents a degree of damage to the national security that could be done by letting this material get into the hands of unauthorized persons. The category also determines how the material is handled and the measures used for its safeguard.

SPECIAL MARKINGS.—In addition to the security categories mentioned already, other category markings also appear on classified material. Among these markings are such designations as Restricted Data and For Official Use Only.

Special Handling Required.—The term *Not Releasable to Foreign Nationals* is not a category of classification, but is assigned to classified material to prevent inadvertent disclosure to foreign nationals, and it requires special handling. This term is often abbreviated within the Navy as NOFORN, and when assigned to classified material it indicates the following: (1) that the material is furnished for the exclusive use of the U.S. military representative on international staffs or in similar circumstances and (2) to holders and other handling personnel that the material involved has already been reviewed by the office of origin or other responsible authority and that disclosure to foreign nationals is subject to special restrictions.

Other United States activities use abbreviations that differ from the Navy's NOFORN, such as the U.S. Air Force, which uses "NO FOREIGN DISSEM," and certain branches of the Department of Defense which use "CONTROLLED DISSEM/NO DISSEM ABOARD."

Restricted Data.—All data concerned with (1) design, manufacture, or utilization of atomic weapons; (2) production of special nuclear material; or (3) use of special nuclear material in production of energy bear conspicuous "Restricted Data" markings. Restricted data, when declassified under the Atomic Energy Act of 1954, must be marked Formerly Restricted Data, Handle as Restricted Data in Foreign Dissemination, Section 144B, Atomic Energy Act, 1954.

For Official Use Only.—The term *For Official Use Only* (FOUO) is assigned to official information that requires some protection for good of the public interest but is not safeguarded by classification categories used in the interest of national security.

Preparation and Markings

Each document or material is classified according to the importance of the information it contains or reveals. It is important that the originator identify individually items of information which require protection. Then the originator considers whether compromise of the document or material as a whole would create a greater degree of damage than compromise of the items individually. The classification of the document or material must be the classification that provides protection for the highest classified item of information or for the document or material as a whole, whichever is higher.

The purpose of the markings required for classified material is to record the proper classification, to inform recipients of the assigned classification, and to indicate the level of protection required. The markings also indicate the information that must be withheld from unauthorized persons to provide a basis for derivative classification and to facilitate downgrading and declassification actions.

Upon assignment of a classification category to information, it is immediately marked clearly and conspicuously on all documents. The classification marking of TOP SECRET, SECRET, or CONFIDENTIAL is stamped, printed, or written in capital letters that are larger than those in the text or the document. The marking is mandatory in addition to the typed or printed designation required by the *Department of the Navy Correspondence Manual*. On materials other than paper products, the classification marking is stamped, printed, written, painted, or affixed by means of a tag, sticker, decal, or similar device in a conspicuous manner. If marking is not physically possible on the material, written notice of the assigned classification is provided to recipients of the material.

Custody

Commanding officers are directly responsible for the custody (safeguarding) of all classified material. They are also responsible for establishing measures for the inspection of safe-storage containers and areas where classified material is kept to ensure compliance with security regulations. The term *commanding officer* is intended to include competent authority, commander, officer in charge, naval representative, director, and inspector. This term also includes any other title assigned to an individual, military or civilian, who, through position or status, is qualified to assume responsibility and render decisions.

NUMERICAL EVALUATION SYSTEM.—A system has been developed for providing a uniform guide for establishing security protection of classified material in storage that is equal in value to the classification of that material. This system does not guarantee protection, nor does it attempt to meet every conceivable situation, but with a commonsense approach, it is possible to obtain a satisfactory degree of security with minimum sacrifice in operating efficiency.

This system is called the numerical evaluation system. It contains two elements: (1) a table of numerical equivalents which assigns numerical values for various types of storage areas, containers, and alarm systems which by themselves, or together, may be used in the security program for the protection of classified material and (2) an evaluation graph which establishes, in the form of numerical values, minimum levels of security required for protection of classified material. This protection is based on the classification, the quantity of the material, and the scope of the material.

COMBINATIONS.—In keeping with the Navy's security principle of "need to know," combinations to locks of classified containers should be known only to those who actually control the classified material. Also, a record of combinations should be sealed in an envelope and kept on file by the person designated by the commanding officer.

When you are selecting combinations, personal data, such as birth dates and service numbers, multiples of five, and simple ascending or descending arithmetic series should be avoided. A combination should never be used for more than one container in any one component.

After securing (closing) dial combination locks, the dial should be rotated at least four complete turns in the same direction. The drawers of safes and cabinets should be checked to assure they are held firmly in the locked position.

Custodians

Custodians of classified material are responsible for providing protection and accountability for that material at all times. They are also responsible for locking classified material in appropriate security equipment whenever the material is not in use or under direct surveillance of authorized persons.

Classified material should not be removed from working areas for the purpose of working on such material during off-duty hours, or for any other purpose that involves personal convenience. However, when classified material is removed from the physical confines of the command, as when it is taken to a conference or other area, a complete list should be prepared by the individual removing the material. This list should be filed according to local directives.

EMERGENCY PLANNING.—Plans must be developed by each command for the protection, removal, or destruction of classified material in case of natural disaster, civil disturbance, or enemy action. Such plans should establish detailed procedures and responsibilities for the protection of classified material so that it does not fall into unauthorized hands. The plan should also indicate what material is to be guarded, removed, or destroyed. An adequate emergency plan provides for the following: (1) guarding the material; (2) removing the classified material from the area; (3) complete destruction of the classified material on a phased, priority basis; or (4) some combination of these actions. However, reducing the amount of classified material on hand and maintaining only current and necessary material can be the most effective step toward planning for an emergency situation.

Emergency plans should provide for the protection of classified information in a manner which will minimize the risks of loss of life or injury to personnel.

ACCOUNTABILITY.—Except for publications containing a distribution list by copy number, all copies of Top Secret documents must be serially numbered at the time of origination in the following manner: "Copy No. ____ of ____ copies."

Top Secret documents should contain a list of effective pages; this list should include a record of page checks. When this is impractical, as in correspondence or messages, the pages should be numbered as follows: "Page ____ of ____ pages."

Commanding officers establish administrative procedures for recording all Secret material originated and received and maintain a receipting system for all Secret material distributed or routed to activities outside their commands. As a general rule, Secret materials are also serially numbered.

Commanding officers also provide accountability for all Confidential materials originated or received by their commands.

Access

Personnel whose work requires access to classified material must be granted an appropriate clearance. The standards for the various categories of clearances are different, but they all follow a basic format for both civilian and military personnel. Essentially, the standards are that no person should be permitted knowledge of, possession of, or access to classified material solely by virtue of rank, position, or security clearance. Clearance serves to indicate that the persons concerned are eligible for access to classified material should their official duties so require. No person will be granted a security clearance unless it has been determined that the clearance is in keeping with the interests of national security.

Any person authorized access to classified information must be considered to be loyal, of good character, of good integrity, trustworthy, and of such habits and associations as to indicate good discretion or judgment in the handling of classified information.

The ultimate determination of whether the granting of a clearance is in keeping with the interests of national security must be an overall determination based on all available information. Personal data, both past and present, that are investigated and considered before granting a clearance include the following: any criminal, infamous, dishonest, or notoriously disgraceful conduct; habitual excessive use of intoxicants; drug abuse; sexual perversion; and any excessive indebtedness, recurring financial difficulties, unexplained affluence, or repetitive absences without leave which furnish reason to believe that the individual may act contrary to the best interest of national security.

SECURITY CLEARANCE.—A personnel security clearance requires an administrative investigation by competent authority and certifies that the person is eligible for access to classified material of the same or lower category as the clearance being granted. Security clearances are of two types:

1. Final clearance—one granted upon completion of the required investigation
2. Interim clearance—a temporary eligibility for access to classified information based on a lesser investigative requirement

An interim clearance should be issued only when it is clearly established that the delay while waiting for the completion of the investigation required for a final clearance would be harmful to the national interest. When interim clearance procedures are used, the investigation required for a final clearance must be initiated, and a final clearance should be executed upon the satisfactory completion of the investigation, unless such clearance is no longer required.

REQUIREMENTS FOR SECURITY CLEARANCE.—The clearance requirements listed below are solely for military personnel.

Top Secret.—The investigative requirements for access to Top Secret material are as follows:

1. Final clearance—a Background Investigation plus a records check by the issuing command;

however, any person having a Top Secret clearance based on a National Agency Check before 1 Jan. 1973 with 15 years of continuous active duty does not require a Background Investigation.

2. Interim Clearance—a satisfactory completion of a National Agency Check.

Secret.—For access to Secret material, a final clearance requires a National Agency Check plus a records check by the command. An interim clearance cannot be issued to personnel (1) with less than two consecutive years of active duty and (2) until a name check has been made with the Defense Central Index of Investigations and with NMPC files.

Confidential.—No formal investigation is required for the issue of a Confidential clearance, provided a records check by the issuing command notes no derogatory information. An interim clearance for Confidential is not authorized.

TYPES OF PERSONNEL SECURITY INVESTIGATIONS.—Personnel security investigations are of the following types:

1. National Agency Check
   a. National Agency Check and Inquiry
2. Background Investigation

National Agency Check.—A National Agency Check consists of a check with various federal agencies for pertinent facts having a bearing on the loyalty and trustworthiness of the individual. The initial NAC conducted on inductees and first term enlistees does not include detailed technical fingerprint search and is referred to as an ENT-NAC.

A National Agency Check and Inquiry (NACI) consists of a National Agency Check (described above) and Written Inquiries sent to law enforcement agencies, former employers, references, schools attended, etc., for pertinent facts which may have a bearing on the individual's suitability for federal employment.

Background Investigation.—A Background Investigation which is conducted for clearance purposes is designed to develop information as to whether the access to classified information by the person being investigated is clearly consistent with the interest of national security. The investigator should make inquiry into the pertinent facts bearing on the loyalty and trustworthiness of the individual. It normally covers the most recent 15 years of his/her life, or from the date of his/her 18th birthday, whichever is the shorter period. When derogatory information is developed in the course of any investigation, the investigation should be extended to any part of the individual's life necessary to substantiate or disprove the information and to develop adequate information upon which to base a security determination. The investigation may also be expanded when additional investigation is specifically required by competent authority.

Methods of Destruction

Classified material should be destroyed in the presence of appropriate officials by burning, melting, chemical decomposition, pulping, pulverizing, shredding, or mutilation sufficient to preclude recognition or reconstruction of the classified material. This classified material could be either trash from your work in the shop or outdated material scheduled for destruction.

During emergency situations at sea, classified material may be jettisoned at depths of 1,000 fathoms or more. If such water depth is not available and if time does not permit other means of emergency destruction, the material should, nonetheless, be jettisoned to prevent its easy capture. When shipboard emergency destruction plans include jettisoning, weighted document sinking bags should be available. If a vessel is to be sunk through intentional scuttling or is sinking due to hostile action, classified material should be locked in security filing cabinets or vaults and allowed to sink with the vessel rather than attempting jettisoning.

As a last resort, and when none of the methods previously mentioned can be used, the use of other methods, such as dousing the classified material with a flammable liquid and igniting it, can be used as alternatives to certain loss of the material to the enemy.

The importance of beginning destruction sufficiently early to preclude loss of the material is of paramount importance and must be emphasized. The effects of premature destruction are considered relatively inconsequential when measured against the possibility of compromise. Classified material should, when practical, be marked in a manner to indicate its priority for emergency destruction.

RECORDS (E-7)

Records of destruction are required for Top Secret and Secret material and should be dated and signed by two officials witnessing actual destruction; however, if the classified material was placed in burn bags, the destruction record will be signed by the witnessing officials at the time the material was placed in the burn bags.

Persons witnessing the destruction of classified material should do the following:

1. Have a security clearance at least as high as the category of material being destroyed, and they should be thoroughly familiar with the regulations and procedures for safeguarding classified information.
2. Observe the complete destruction of classified documents.
3. Check residue to determine that destruction is complete and reconstruction is impossible.
4. Take precautions to prevent classified material or burning portions of classified material from being carried away by wind or draft.

A record of destruction is not required for Confidential documents.

Negative File and Printing Log

Although the Lithographer does not have an official central file for negatives as the Photographer's Mate (PH) would have, there should be an orderly filing system in each shop.

Since each lithographic printshop has its own needs, when it comes to some files and logs, filing systems vary from ship to ship. Negatives (flats) are usually stored by department and used in conjunction with a card filing system. When this system is used properly and kept up to date, it gives an accurate history of each specific job. You can also check this file before a deployment to help you determine future requirements for supplies.

A properly kept printing log will show you the status of the jobs in your shop but also aid you in determining requirements for stock levels of supplies. These logs should contain information such as the name of the job, the classification, the number of originals, the number of copies to be produced, the date you received the job, and the date of completion.

Navy Maintenance and Material Management System

Maintenance of ships can be divided into two broad categories: preventive maintenance, consisting of routine shipboard procedures designed to increase the effective life of equipment and forewarn of impending troubles; and corrective maintenance, designed to analyze and correct material defects and troubles. The main objective of shipboard preventive maintenance is the prevention of breakdown, deterioration, and malfunction of equipment. If this objective is not reached, repairing or replacing the equipment through corrective maintenance could be required.

In the past, shipboard maintenance programs have varied from one command to another, and this has resulted in varying degrees of operational readiness. However, the Navy adopted a system, known as the Ships' Maintenance and Material Management (3-M) System, which provides for orderly scheduling and accomplishment of maintenance. This system also provides for reporting and disseminating significant information related to maintenance operations. In brief, this system spells out what maintenance operations are to be performed, on what equipment, when they are to be performed (daily, monthly, etc.), and who is to do the job. Under this system, maintenance personnel are also required to fill out certain forms showing that the operation has been performed, how long it took, any problems encountered, and other data which might be useful in compiling the history of the equipment.

The 3-M System is composed of two subsystems: the Planned Maintenance Subsystem (PMS) which pertains to the planning, scheduling, and management of resources (personnel, material, and time) to perform those actions which keep the machines in operation; and the Maintenance Data Collection Subsystem (MDCS) which provides a means for recording and reporting the expenditure of resources (personnel, material, and time) associated with certain categories of maintenance. The MDCS also provides a system for processing maintenance and logistic information and for its dissemination. This information provides technical data for maintainability/reliability studies of operational equipment and management information for improving workload planning and control. Much of this information is provided in code form for standardization and to facilitate automatic data processing.

Your role in the system as a PO1 or CPO includes the training of junior personnel in its use as well as scheduling and supervising maintenance operations. Maintenance personnel are responsible for (1) reading the weekly schedules every day and performing the PMS actions scheduled, (2) knowing how to fill in MDCS documents, and (3) informing their supervisor of completed and uncompleted operations and any problems encountered in performing the work. Through the use of a cycle schedule, a quarterly schedule, and a weekly schedule, the PMS is designed to simplify the scheduling of planned maintenance. All required actions are programmed for certain pieces of equipment. Forms are provided to show the minimum maintenance required and describe the methods, materials, and tools to be used. In addition, the system is flexible enough to readily accommodate any changes in a ship's employment schedule.

Recording Maintenance Actions

Information for the MDCS is provided by the completion of standard forms, such as the Maintenance Data Form and the Feedback Report.

At the time you perform the maintenance operation, you fill out a Maintenance Data Form to show that the operation has been completed and how long it took. The maintenance performed is recorded in code in sufficient detail to permit the collection of a variety of information concerning maintenance actions and the performance of the equipment involved. The use of codes enables you to get more information in a small space and also facilitates automatic data processing of the information. The MDCS system also provides data concerning the initial discovery of a malfunction of the equipment, how it malfunctioned, and how many hours it was in operation. It also indicates which equipment was involved, what repairs were made, what equipment was used, what delays were incurred, the reason for the delays, and the technical specialty or work center which performed the maintenance. Each maintenance action is reported in this manner, except routine preservation action, such as painting and cleaning.

Equipment Maintenance Duties

In previous chapters you have been given the general maintenance procedures of major items of shop equipment. These procedures include cleaning, adjusting, and lubricating shop presses; servicing and maintaining camera-processors; and the maintenance of cold-type composition machines. Aboard ship lithographic shop equipment may be incorporated into the Ships' Maintenance and Material Management (3-M) System. If your assignment is aboard ship, you may have maintenance duties on a periodic basis. You may be called upon to assist or prepare the weekly schedule of preventive maintenance on such equipment. You should become familiar with the Ships' 3-M System.

Man-hour Reporting

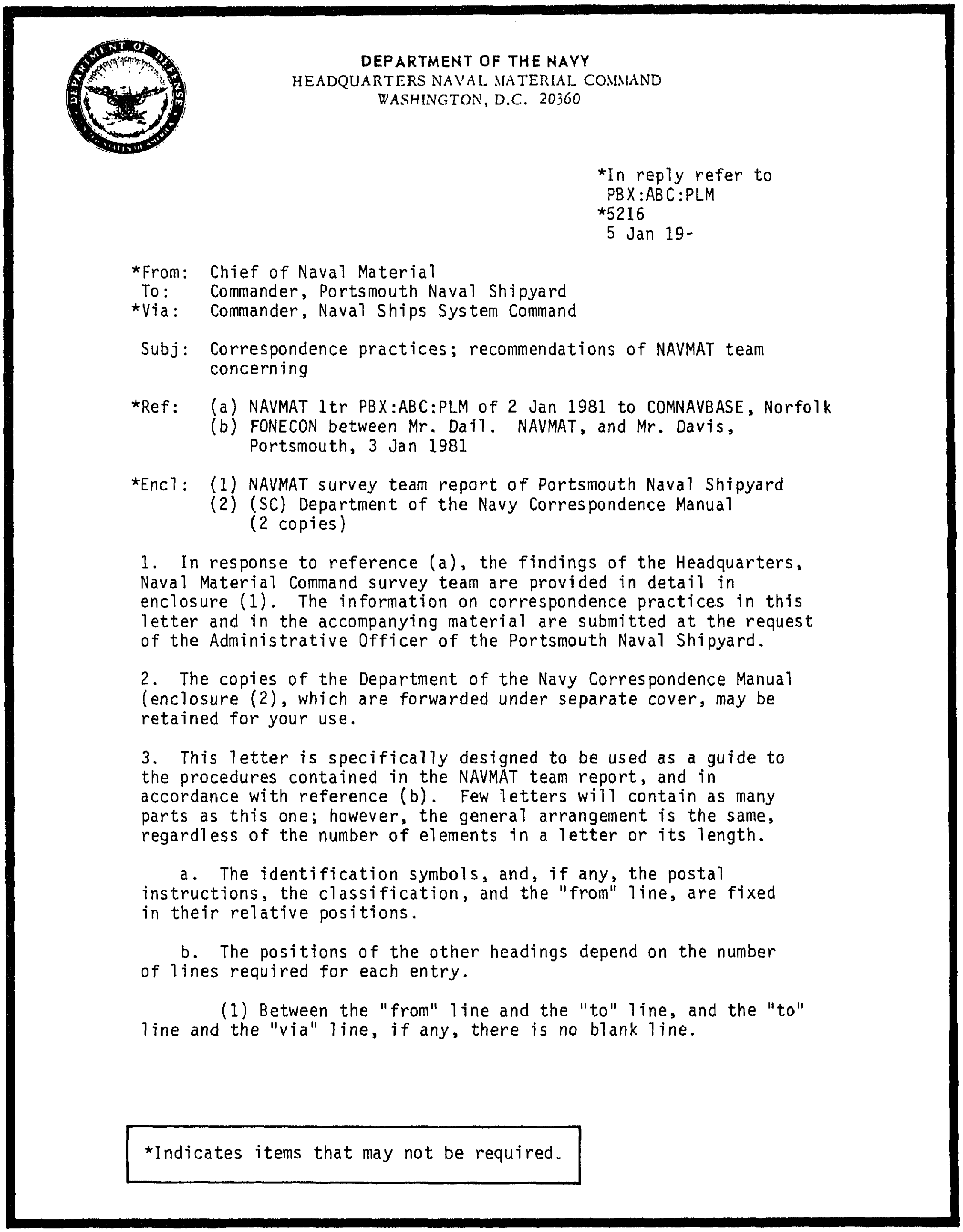
Your department aboard such ships as repair ships and tenders must report on the daily progress of the various jobs they are doing. These reports are made by each work center. Reports can include such items as material expended, cost information, work delays and stoppages, hours of work remaining, and actual man-hours expended on the job. On tenders and repair ships, all working hours of each person must be accounted for, and because the report is intended to show only the time actually spent on the job, another form is used to show the time expended in other activities. This form accounts for deviations from the normal working hours. Exception Time Accounting includes the use of codes and the preparation and submission of daily reports.

Correspondence

The *Department of the Navy Correspondence Manual*, SECNAVINST 5216.5, contains procedures for preparation of official correspondence within the Navy. You should always consult the *Department of the Navy Correspondence Manual* before preparing any letter that is not of a routine nature.

Standard Naval Letters

Figures 17-3 and 17-4 illustrate the standard naval letter in finished form. When preparing correspondence in the rough, always double-space the text to allow for corrections or insertions by reviewing officers. Before starting the letter, find out from the drafting officer (you may physically prepare the draft, but the officer is responsible for the finished product) whether it is to be classified. If so, the classification must appear near the top and bottom of each page. Note the



DEPARTMENT OF THE NAVY
HEADQUARTERS NAVAL MATERIAL COMMAND
WASHINGTON, D.C. 20360

*In reply refer to
PBX:ABC:PLM
*5216
5 Jan 19-

*From: Chief of Naval Material
To: Commander, Portsmouth Naval Shipyard
*Via: Commander, Naval Ships System Command

Subj: Correspondence practices; recommendations of NAVMAT team concerning

*Ref: (a) NAVMAT ltr PBX:ABC:PLM of 2 Jan 1981 to COMNAVBASE, Norfolk
(b) FONECON between Mr. Dail. NAVMAT, and Mr. Davis, Portsmouth, 3 Jan 1981

*Encl: (1) NAVMAT survey team report of Portsmouth Naval Shipyard
(2) (SC) Department of the Navy Correspondence Manual (2 copies)

1. In response to reference (a), the findings of the Headquarters, Naval Material Command survey team are provided in detail in enclosure (1). The information on correspondence practices in this letter and in the accompanying material are submitted at the request of the Administrative Officer of the Portsmouth Naval Shipyard.

2. The copies of the Department of the Navy Correspondence Manual (enclosure (2), which are forwarded under separate cover, may be retained for your use.

3. This letter is specifically designed to be used as a guide to the procedures contained in the NAVMAT team report, and in accordance with reference (b). Few letters will contain as many parts as this one; however, the general arrangement is the same, regardless of the number of elements in a letter or its length.

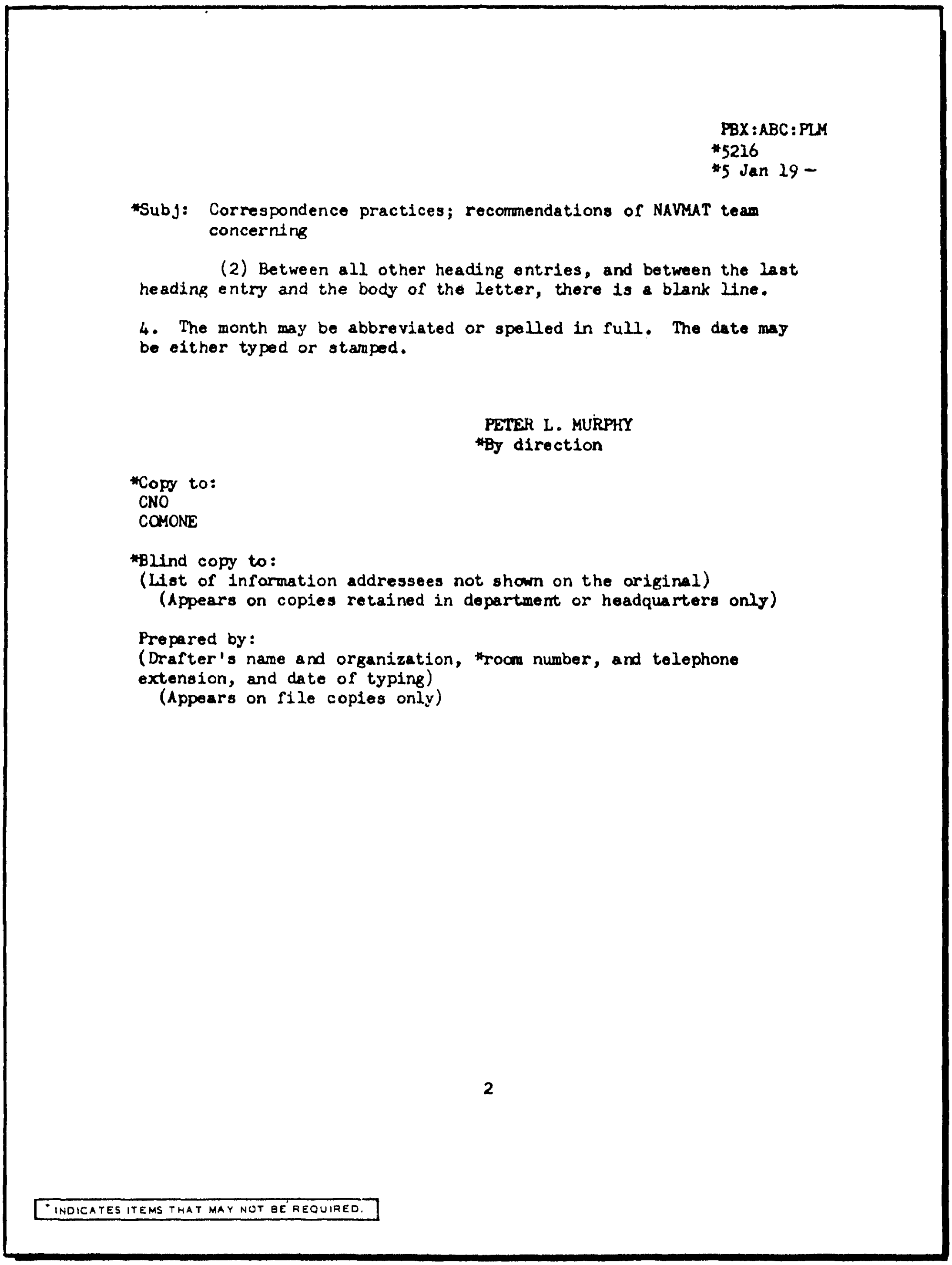
a. The identification symbols, and, if any, the postal instructions, the classification, and the "from" line, are fixed in their relative positions.

b. The positions of the other headings depend on the number of lines required for each entry.

(1) Between the "from" line and the "to" line, and the "to" line and the "via" line, if any, there is no blank line.

*Indicates items that may not be required.

Figure 17-3.—Standard naval letter.



PBX:ABC:PLM
*5216
*5 Jan 19 –

*Subj: Correspondence practices; recommendations of NAVMAT team concerning

(2) Between all other heading entries, and between the last heading entry and the body of the letter, there is a blank line.

4. The month may be abbreviated or spelled in full. The date may be either typed or stamped.

PETER L. MURPHY
*By direction

*Copy to:
CNO
COMONE

*Blind copy to:
(List of information addressees not shown on the original)
(Appears on copies retained in department or headquarters only)

Prepared by:
(Drafter's name and organization, *room number, and telephone extension, and date of typing)
(Appears on file copies only)

2

* INDICATES ITEMS THAT MAY NOT BE REQUIRED.

95.17

Figure 17-4.—Standard naval letter—Continued.

identification and indentation of paragraphs and subparagraphs. The drafting officer will have to determine who the "via" and "copy to" addressees (if any) are to be. There are two important rules of thumb: (1) references shown in the heading of the letter should be mentioned (in chronological order) within the text at least once and (2) unless they are very closely related, do not cover two subjects in one letter. The latter practice can result in administrative confusion when replies are required.

When preparing correspondence, bear in mind that the usual purpose of Navy mail is to provide the reader with concisely stated information. If you turn out a confused, rambling, repetitious, or needlessly lengthy masterpiece of semantic purity, you only create an editing chore for the drafting officer—and you may wind up doing the whole thing over.

Before starting the letter, be sure you understand exactly what the letter is to accomplish. Then its organization becomes essentially simple. The first paragraph should state the purpose of the letter; the following paragraph(s) explain circumstances and state the action (give orders, make requests, give consent, or refuse permission).

When the letter is in answer to, or closely related to another letter, the first sentence should refer to that letter. For example: "1. Reference (a) requested information about the allowance lists for the next 3 fiscal years. Reference (b) pointed out that such information is available for only 2 years in advance. . . . "

The usual causes of confusion and rambling in a letter are as follows:

1. Failure to follow the basic pattern (purpose, circumstances, action)
2. Inclusion of more than a single idea in a sentence, more than one central thought in a paragraph, or more than a single subject in the letter
3. Failure to consider the readers (can the letter be misinterpreted?)

In letters of average length, each significant unit may be one paragraph, although there is no rule about this. Explaining the reasons why something should be done may take more than one paragraph, while other letters are so simple that a single paragraph makes up the entire body. The important thing for the writer is to (1) arrange the units in what seems the most satisfactory order, (2) complete each unit before moving on to the next, and (3) maintain continuity by providing transition from one unit to another.

When you prepare the first draft, don't worry too much about the finished product. Get something on paper. You can go over it later for errors, clarity, and good order. If possible, let the first draft cool for awhile and occupy your mind with other matters before going over it again. This practice tends to make you more objective—you will find flaws not apparent to you earlier. Delete unneeded words, cut down the big ones, take out the intensives (very much, extremely), eliminate unnecessary introductory phrases, such as "it is to be noted" and "we call your attention to the fact that," and avoid repetition; I repeat, avoid repetition.

Memorandum

Although there are variations of the form of naval correspondence called a memorandum, the one most frequently used is the simple "From-To" type between subordinates within the same activity.

A preprinted Department of the Navy Memorandum (short or long) form is available. You may also use a plain or letterhead (when the memorandum is addressed outside the organization) sheet of paper. When using other than the preprinted form, type "MEMORANDUM" in capital letters at the left margin. Two spaces below that type "From:" and proceed as you would for a naval letter. For very informal communications, memoranda may be handwritten.

Variations of the "From-To" style include the "Memorandum For" and "2-Way Letter-Memo" types. The former is used between high-level officials within the Department of Defense. The "2-Way" incorporates the efficiencies of a preprinted format and preinserted carbon; it is used only for communications that require a reply.

Messages

A message is a written thought or idea, expressed briefly and to the point, and prepared for transmission by the most suitable means of telecommunication.

The originator of a message is the command by whose authority the message is sent. The drafter—usually the communications officer or a department head—is the person who actually composes the message for release. The releasing officer authorizes transmission of the message for and in the name of the originator. Usually the commanding officer is releasing officer, but may delegate the releasing authority. With a few exceptions, military messages are arranged in a basic naval message format.

Communications requiring expeditious delivery are prepared for transmission as brief, concise messages with a message heading and a message text.

SUPPLY DUTIES

You or someone in your shop should look after all lithographic supplies. This means that you must see that all necessary supplies are kept on hand and that they are properly stowed and distributed as they are needed.

Policies for storing supplies differ somewhat between the different types of ship. Generally, paper stock and repair parts are stored in the ship's storerooms, and other supplies are forwarded to the printshop as soon as they are received by the supply department. It will then be your responsibility to store them properly.

If you are able to get space assigned in a storeroom, you can use it for storing your supplies. If no such space is available, you must store the supplies on shelves or in cabinets in your lithographic shop.

It is best to group everything of the same kind of supplies or parts in the same spot. You should keep the most frequently used items in the most accessible places. Open only one package at a time and mark the other packages so you can tell what is in them without tearing out their corners.

Items which have an expiration date or specified shelf life should be arranged so that the older stock will be used first, and such items should be stored in areas where they will not be damaged by sweating bulkheads, light, or heat.

You may be able to work out a high and low stock level for your supply items so that when these items reach a certain level you will know to reorder them. This system will work for items stored in the printshop itself or in supply because you will be keeping a running inventory of items and recording them. When they reach the low limit, you will know to reorder. A running inventory enables you to know how much stock you have on hand at any time and also serves as a guide to you in determining how much stock to order. After a short time, you will begin to know approximately how much of each item you are using during a week, and this will enable you to judge how much longer the supplies will last and how much should be ordered at a time.

In addition to the running inventory, you should make a physical check of the stock in the lithographic shop and in the ship's storerooms at regular intervals. Always check the condition of the supply materials and parts as well as the quantities on hand.

Repair Parts

When ordering repair parts for equipment aboard ship, you should consult your ship's Consolidated Shipboard Allowance List (COSAL). Your department head or division office should have a copy of the COSAL section which lists all equipment in the department. This listing includes under each item of equipage, the spare or repair parts considered necessary to support or maintain that equipment. You can use the nomenclature, stock number, and other information listed when you fill out the form requesting an item through the supply office.

If the required part is not listed in COSAL, you should consult the manufacturer's catalog or the operator's manual for the equipment to find the manufacturer's number or stock number and description of the repair part. You should then furnish complete and detailed information on repair parts to assist the supply department in procuring the part. You should obtain and attach the appropriate forms to the supply office.

The supply office has a complete listing of all manufacturer's instruction books available from the supply system. Many of these books have a parts list section. You can also obtain instruction books and parts lists by writing to the manufacturer of each piece of equipment.

In cases where it is necessary to procure the items which you are requesting from sources outside the ship, the Storekeeper will use the information supplied by you to prepare a formal requisition. The Storekeeper will write in the number assigned to the formal requisition on one copy of your request form and return this copy to you for your files. You should refer to this requisition number if it is necessary for you to make inquiries about the item ordered.

If the item requested is not stocked by the Navy, the supply office will prepare a requisition requesting a purchasing activity ashore to procure it through a commercial supplier.

If you take a thorough inventory and prepare requisitions before your ship's arrival in port, your supply requests can be turned over to the local supply department on your arrival. When this is done, the supply department will be in a better position to furnish the required items while your ship is still in port. This could prevent a shortage of critical items at a later date when you are at sea, far from a source of supply.

While it is desirable to have adequate supplies on hand, do not go overboard and overstock. Overstocking your printshop or ship's storerooms deprives the ship of valuable space and may also lead to waste, since many of the Lithographer's supply items deteriorate with age.

Imprest Funds

If your ship has an imprest fund, you can make emergency purchases across the counter and pay for them with cash. The imprest fund provides a simple and economical method for purchases which do not exceed $100. It is similar to the petty cash funds used by private industry.

The imprest fund is in the custody of a member of the supply department who acts as the imprest fund cashier. When a purchase is required, this person advances these funds to the person who is to pick up the merchandise (you or your representative) and will require you to sign a receipt for the money. The cashier will retain this receipt and will give the man a receipt for cash, which must be filled in by both you and the supplier at the time the purchase is made.

Before attempting to purchase supplies in this manner, you should contact the supplier to determine if the materials are available and their approximate selling price. You should then make the appropriate form containing this information and present it to the supply office a day or two in advance if time permits. It is better to make arrangements to pick up the money early in the morning so that the supplies can be obtained and the forms can be returned to the cashier the same day.

The person who picks up the money should carry the money and all the forms to the supplier. Once the purchase is completed, have the supplier fill in the form. After returning to the ship, you must turn the form over to the cashier (as evidence of the expenditure) along with any change from the fund which was advanced to you.

Drawing Materials from the Storeroom

You will need to fill out the required forms to draw materials from your ship's storeroom as well as for requesting the supply office to procure materials from sources outside the ship.

The stock number is important in identifying any item. If it is available, list it on the form. You should also list the correct unit of issue (ream, sheet, etc.). If you are in doubt as to the correct unit of issue, consult the supply department.

Your department head may sign the form before you submit it to the supply office. Aboard some ships, the department head may also require that each form pass through the person maintaining your departmental budget record before it is taken to the supply department.

The person sent with the request approved by the department head to draw the material usually has to get it cleared with the supply office before going to the storeroom. However, aboard ships where stock records are kept entirely in the storeroom, the person may go directly to the storeroom. Be sure to instruct the person drawing the material to see that each item is received in the correct quantity before he/she signs for it and to get a copy of the form showing the correct quantity and price of the material received.

Procuring New Equipment

When a ship is constructed or converted, if it is to have a lithographic shop aboard, Navy Publications and Printing Service (NPPS) obtains the necessary approval. Then they forward the authorization for establishment of the shop to the shipbuilder (or supervisor of shipbuilding) and to the ship's prospective commanding officer.

A layout for the lithographic shop is made according to the equipment to be furnished and the space available. This layout is forwarded to the shipyard where the supervisor of shipbuilding sees that the proper foundation is placed under the deck to support the presses and equipment and that electrical outlets, water pipes, and so on, are built according to the specifications.

There are many things that must be considered in planning a ship's lithographic shop. For example, sinks should be placed with their long dimension running fore and aft to reduce splashing caused by the roll of the ship. This also applies to the dimensions and placement of the water fountain on the presses. Cabinets should, when possible, be placed so that they open fore and aft to reduce the danger of the doors and drawers opening during rough weather.

To save time in writing specifications for your shop and to make sure that nothing is overlooked, NPPS has devised a plan for furnishing the initial lithographic shop to ships and advance base units in one package. This package is available to you upon request.

Besides standard lithographic equipment for advance base shops, there are generally included such items as quonset huts, diesel-electric generators, electric outlets, and air-conditioning units. You must also include items which seem insignificant, but are important. These items include flashlights, batteries, shovels, and even needles for sewing the ends of the dampener covers. This group of items constitutes the basic inventory of the shop. Your commanding officer must submit by letter the changes desired along with justification for them to request an increase or decrease in your existing allowance.

When you are requesting equipment replacement, your commanding officer must submit to NPPS a letter request with complete narrative justification for the proposed purchase, rental, transfer, or disposal of the equipment concerned.

NPPS reviews all ship and type commander requests for the purchase, rental, transfer, or disposal of items of printing, binding, and related or auxiliary equipment. If a request is adequately justified, NPPS obtains necessary authorization and forwards approval of the proposed action via the responsible type commander to the commanding officer of the ship concerned along with disposition instructions for the old equipment.

As soon as the approved action has been completed in your shop, your commanding officer should submit a letter report (containing the make, model, serial number, and actual purchase price of the acquired equipment) to the Director, Navy Publications and Printing Service. The NPPS maintains a perpetual inventory for each shipboard printing plant.

Surveys and Disposal

A survey is a procedure required by Navy regulations when Navy property must be condemned as a result of damage or deterioration; appraised because it has lost its utility; or declared nonexistent because it has been lost or stolen. The primary purpose of a survey is to ascertain the condition of the material, to determine the cause of this condition, to fix responsibility for the condition, and to make a recommendation for the disposal of the material. At some time, you will likely be involved in a survey of damaged or deteriorated stock or of some item of equipment which falls into one of these categories.

If you have a stock item or a piece of equipment which you think should be surveyed, you should call it to the attention of your division officer. The division officer reports it to the department head who submits a survey request form to the commanding officer via the supply officer. The commanding officer appoints a survey officer or a board of three persons to investigate and report on the matter.

When the survey is completed, the report is turned over to the CO for approval. If the surveyed item consists of supplies, the CO forwards the approved survey paper to the supply office to be used as authority for expending the material from the books or for reducing it in value. An additional step is required if the surveyed item is lithographic plant equipment.

All Navy lithographic shops must request approval from NPPS for the disposal of equipment. NPPS will give approval for a change in the shop's allowance and disposition instructions for the equipment at the same time.

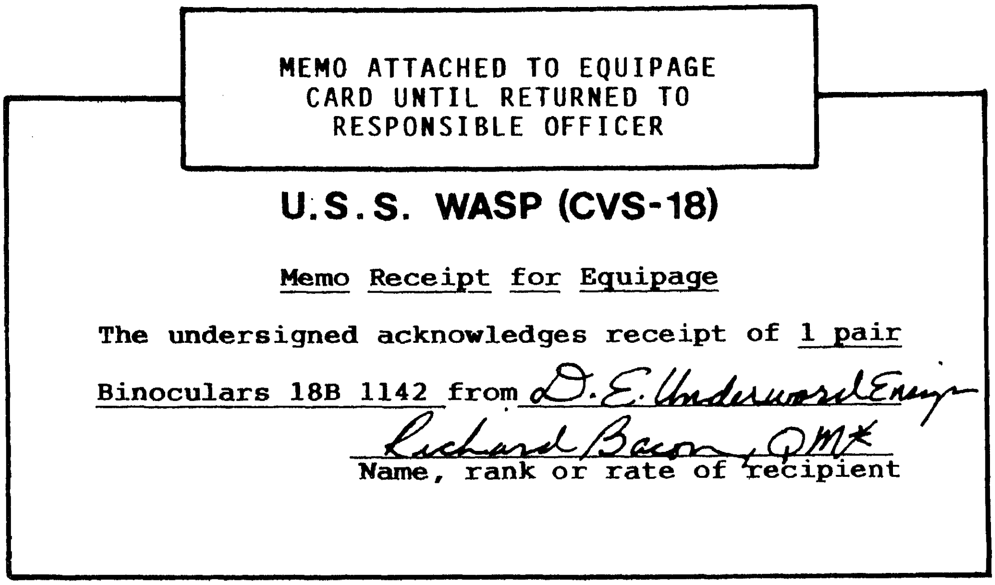
Custody Cards

When you receive a piece of valuable equipment, such as a lens or micrometer, you will be asked to sign a custody card making you responsible for it. The head of the department maintains a file of these cards which may be used for reference in making the annual inventory.

Much of your equipment is valuable. If you lend it to someone else, you should obtain a receipt for it. This receipt should be similar to that shown in figure 17-5. You may want to assign one of your Lithographers the responsibility of keeping up with all valuable equipment.

Requisitioning Supplies

If you are the supply PO, you will be given training by your activity's supply department to



MEMO ATTACHED TO EQUIPAGE
CARD UNTIL RETURNED TO
RESPONSIBLE OFFICER

U.S.S. WASP (CVS-18)

Memo Receipt for Equipage

The undersigned acknowledges receipt of 1 pair
Binoculars 18B 1142 from D. E. Underwood Ensign
Richard Bacon, QM*
Name, rank or rate of recipient

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Figure 17-5.—Memo receipt for equipage.

enable you to properly fill out the required forms and to maintain the supply records required. These forms must have such information as the Federal Supply Number (FSN) of the item, its unit of issue, the quantity requested, the cost of the item, and a document number comprised of a date code and requisitioner code.

Your department head may sign the form before you submit it to the supply department. At some activities, the department head may require it to be logged in a master log kept within the department for accounting purposes. Once the form has been logged in and signed, it is taken to the supply department for issue if the material is on board or it is ordered through the supply system. Be sure that any material that is received is carefully inspected before you accept it. If the shipment is satisfactory, it is signed for and the form should be retained for the shop records.

Shipboard Inventory

The basic inventory document for ships having a lithographic shop is the Annual (Fiscal Year) Plant Inventory (JCP Form No. 5). This form is prepared by each ship to reflect inventory conditions existing at the date of preparation.

The JCP Form No. 5 prepared for the period ending 30 June 1963 is considered to be the basic inventory document for those ships in active service on that date.

Newly constructed or ships converted after 30 June 1963 must prepare and submit an initial JCP Form No. 5 in triplicate to the Chief of Naval Operations within 10 working days after commissioning. In these cases, the initial report is considered to be the basic inventory document.

Thereafter, within 10 working days after the end of each fiscal year, each shipboard lithographic shop must submit a report to the Chief of Naval Operations listing on a cumulative basis all deviations from the basic inventory document for the ship.

WORK REQUESTS

If your lithographic shop is aboard a cruiser, the chances are that you will be concerned only with work for your own ship. However, if you are aboard a repair ship, a tender, or a carrier, you will probably do work for other ships as well as for your own.

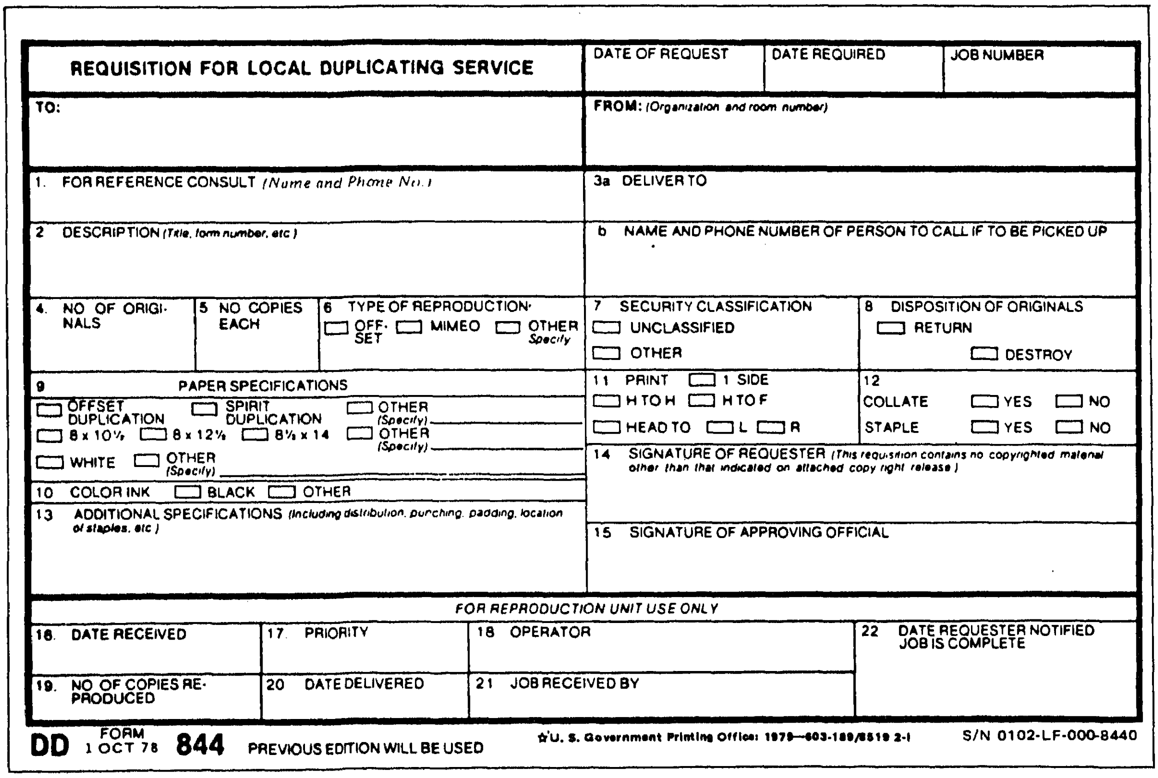
Procedures for handling printing requests vary from one type of ship to another. On some ships, all customer's requests must be approved by the repair officer. On others, requests are approved by the administrative officer or the ship's secretary. You should know your printing officer's policy on accepting work. If this officer requires that all requests be routed to the department head or other officers and offices concerned, you should make sure that all requests complete the routing.

As a senior Lithographer, you should be aware of the rules and regulations governing printing. If you receive a request for a job that you believe should not be printed in your shop, it is your responsibility to bring it to the attention of the printing officer. It is also a good idea to show the printing officer the authority (such as NAVSO P-35, or some other official publication or instruction) on which you base your opinion.

The party requesting the printing may furnish you with a requisition, like that shown in figure 17-6, or the request may be submitted to you in the form of a memorandum or similar form. In any case, the form should supply instructions as to the number of originals, size, quantity, color of ink, kind of stock, classification, and date needed.

You should check the instructions to see if they are complete and if all necessary copy has been furnished. In requesting information from a customer, remember to get as complete a picture of the job as possible. It is better to get more information than you need than to end up with too little information.

Once all the information is in, you should assign the job a number and write it up on a work request form or a work jacket, like the one in figure 17-7. A work jacket is used for scheduling purposes in larger shops. Such a format usually shows promised delivery dates and the progress of the work as it travels through the shop. Some jackets also have painted columns and headings, showing scheduling, availability of presses, and types of paper, ink, and plates in stock. Printing requests are generally prepared in duplicate, one being filed away while the other accompanies the job through the shop. In some shops, the job is then logged in a ledger, like the one in figure 17-8. The complete job should always be routed through the shop in a work jacket or in a protective envelope with the printing request attached.



REQUISITION FOR LOCAL DUPLICATING SERVICE

DATE OF REQUEST

DATE REQUIRED

JOB NUMBER

TO:

FROM: *(Organization and room number)*

1. FOR REFERENCE CONSULT *(Name and Phone No.)*

3a DELIVER TO

2 DESCRIPTION *(Title, form number, etc.)*

b NAME AND PHONE NUMBER OF PERSON TO CALL IF TO BE PICKED UP

4. NO OF ORIGINALS

5 NO COPIES EACH

6 TYPE OF REPRODUCTION· ☐ OFFSET ☐ MIMEO ☐ OTHER *Specify*

7 SECURITY CLASSIFICATION ☐ UNCLASSIFIED ☐ OTHER

8 DISPOSITION OF ORIGINALS ☐ RETURN ☐ DESTROY

9 PAPER SPECIFICATIONS

☐ OFFSET DUPLICATION ☐ SPIRIT DUPLICATION ☐ OTHER *(Specify)* ____

☐ 8 x 10½ ☐ 8 x 12½ ☐ 8½ x 14 ☐ OTHER *(Specify)* ____

☐ WHITE ☐ OTHER *(Specify)* ____

11 PRINT ☐ 1 SIDE ☐ H TO H ☐ H TO F ☐ HEAD TO ☐ L ☐ R

12 COLLATE ☐ YES ☐ NO

STAPLE ☐ YES ☐ NO

10 COLOR INK ☐ BLACK ☐ OTHER

13 ADDITIONAL SPECIFICATIONS *(Including distribution, punching, padding, location of staples, etc.)*

14 SIGNATURE OF REQUESTER *(This requisition contains no copyrighted material other than that indicated on attached copy right release.)*

15 SIGNATURE OF APPROVING OFFICIAL

FOR REPRODUCTION UNIT USE ONLY

16. DATE RECEIVED

17. PRIORITY

18 OPERATOR

22 DATE REQUESTER NOTIFIED JOB IS COMPLETE

19. NO OF COPIES REPRODUCED

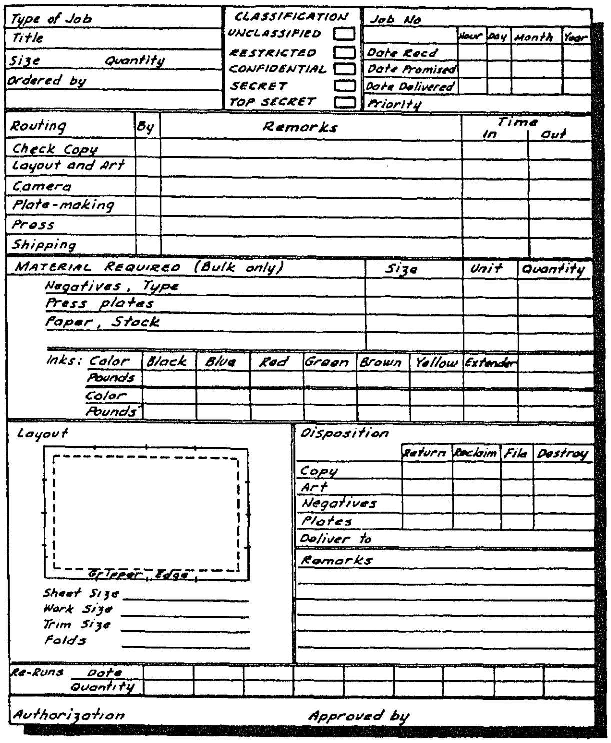
20 DATE DELIVERED

21 JOB RECEIVED BY

DD FORM 1 OCT 78 844 PREVIOUS EDITION WILL BE USED ☆U. S. Government Printing Office: 1979—603-189/8519 2-1 S/N 0102-LF-000-8440

113.264

Figure 17-6.—Printing request.



Type of Job
Title
Size Quantity
Ordered by

CLASSIFICATION
UNCLASSIFIED ☐
RESTRICTED ☐
CONFIDENTIAL ☐
SECRET ☐
TOP SECRET ☐

Job No	Hour	Day	Month	Year
Date Recd				
Date Promised				
Date Delivered				
Priority				

Routing	By	Remarks	Time In	Time Out
Check Copy				
Layout and Art				
Camera				
Plate-making				
Press				
Shipping				

MATERIAL REQUIRED (Bulk only)	Size	Unit	Quantity
Negatives, Type			
Press plates			
Paper, Stock			

Inks: Color	Black	Blue	Red	Green	Brown	Yellow	Extender	
Pounds								
Color								
Pounds								

Layout
Gripper Edge
Sheet Size
Work Size
Trim Size
Folds

Disposition

	Return	Reclaim	File	Destroy
Copy				
Art				
Negatives				
Plates				

Deliver to
Remarks

Re-Runs									
Date									
Quantity									

Authorization
Approved by

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Figure 17-7.—Work jacket.

You should always put complete handling instructions on the work order to assure coordination of the job and to minimize errors in passing on information. After the job has been completed, if it is unclassified, you should file the original and three or four untrimmed samples in the work jacket or by some other suitable system.

Always check the completion date requested for each job. Occasionally, you will find that the job is already overdue by the time you receive the requisition. Make an accurate estimate as to when you can complete the job and let the printing officer or ordering activity know when the work will be ready. This will prevent bad feeling and will also allow the ordering activity to revise its plans, if necessary.

Do not allow your shop personnel to assign priorities to the work requests. Only you, as the senior Lithographer, or your designated assistant should be responsible for assigning priorities and completion dates. Keep your printing officer informed as to your workload, especially when schedules are tight. This will give the printing officer an idea of the status of all important jobs and will help in deciding on priorities for rush jobs presented to the printing officer.

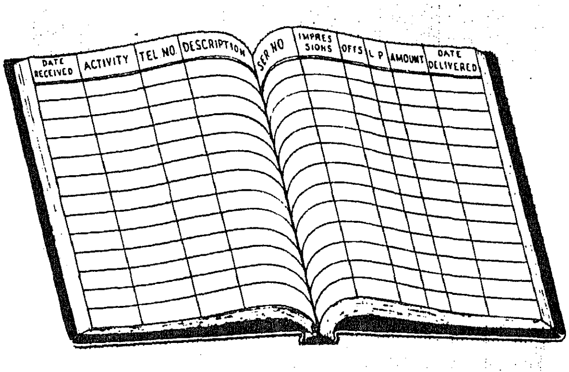

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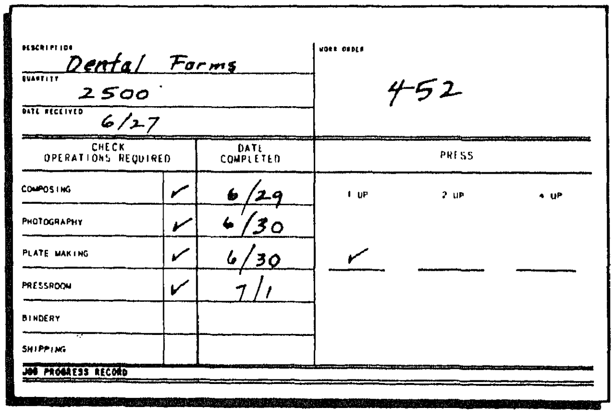
Figure 17-8.—A ledger may be used for logging work in and out of the shop.

Jobs are generally completed in the order in which they are received. However, urgent or important jobs may be given priority over the more routine work. If a classified job comes into the shop, you may decide to stop other operations and put it through the same day due to the security measures involved in keeping it in the shop overnight.

Control Cards

Some lithographic shops maintain a control card, like the one shown in figure 17-9, for each job. This card may be used in addition to or in place of the ledger log. It enables you to check the progress of the work at any time.



DESCRIPTION Dental Forms
QUANTITY 2500
DATE RECEIVED 6/27
WORK ORDER 4-52

CHECK OPERATIONS REQUIRED		DATE COMPLETED
COMPOSING	✓	6/29
PHOTOGRAPHY	✓	6/30
PLATE MAKING	✓	6/30
PRESSROOM	✓	7/1
BINDERY		
SHIPPING		

PRESS		
1 UP	2 UP	4 UP
✓		

JOB PROGRESS RECORD

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Figure 17-9.—Control card.

Regardless of which system you use, the important thing is to keep it simple, workable, and up to date.

Estimating by the Lithographer

There will be times when you will be called upon to estimate in advance the time that will be required to complete a job. If the job is small, the task will be fairly simple, but if it is large, the estimate can be difficult, because so many factors must be considered.

Estimating for Offset

When the job is to be run offset, you must consider such things as the condition of the copy; the time required for composition, artwork, drafting, and corrections; the availability of chemicals and supplies; the time required for preparing the chemicals; and the makeready time for the presses, as well as the actual operating time for each section. The skill and efficiency of the operators and the possibility of breakdowns or delays must also be taken into consideration.

Although it is hard to really set actual times for various operations, the following figures have been included to guide you in making time estimates. You can use them as a guide, but you will find it necessary to modify them according to the job and the operating conditions in your lithographic shop.

Operation	Time
Estimating, scheduling, writing up job, artwork, and corrections	60 min
(This estimate depends, of course, on the condition of the copy. Some jobs may require no artwork or corrections; others may require from 15 minutes for simple additions, such as reference marks or numbers, to several days for extensive corrections.)	
Negative making:	
Initial preparation of chemicals and equipment	60 min
Line negatives:	
First negative, using scale focusing	15 min
First negative, using ground glass focusing	30 min
Each additional negative (at same camera setting)	5 min
Halftone negatives:	
First negative, including setting screen and camera	30 min
(This estimate depends on the skills of the operator.)	
Each additional negative, at same camera setting	15 min
(When using filters with either line or halftone negatives, the time depends on the filter factor. For line negatives, add 50% to the estimated negative making time; add 100% for halftones.)	
Negative opaquing and retouching (minimum)	15 min
Stripping, one negative to a flat	15 min
(Add 5 minutes for each additional negative or position.)	

Plate making:	
Presensitized plates:	
Exposing	10 min
Each additional exposure	6 min
Developing	5 min
Photo-direct plates:	
Exposing and developing	5 min
Wipe-on plates:	
Coating	15 min
Exposing	10 min
Developing	5 min
Presswork:	
Initial preparation and makeready time	60 min
Running time, single color line work (4,000 impressions)	60 min
Running time, register work (2,500 impressions)	60 min
Makeready time for each additional plate with same color of ink:	
10″ x 14″ and 14″ x 20″ presses	5 min
17″ x 22″ or larger	20 min
Cleanup of press for change of color of ink or at the end of the day's run	30 min
Bindery operations:	
Cutting (1,000 sheets)	
1 or 2 cuts	10 min
3 or 4 cuts	15 min
Padding (1,000-5,000 sheets)	30 min
(If drying time is a factor, add at least 90 minutes.)	
Stitching, stapling, and drilling (depending on the skill of the operator and on the job), 700 books	60 min
Folding:	
Original setup	60 min
28″ x 44″ stock (3,000 sheets)	60 min
19″ x 25″ stock (6,000 sheets)	60 min
9″ x 12″ stock (10,000 sheets)	60 min
Gathering (1 person):	
1,500 inserts	60 min
2,000 singles	60 min

To allow for unforeseen delays, some operators add about 55% to the total estimated time. However, you must also remember that under favorable conditions, similar work, continuous production, and overlapping operations will often cut your estimated production time in half.

It is possible, for example, to run up to 100 plates (75 impressions each) per day on the small presses (duplicators), and you can plan on turning out roughly 18,000 to 20,000 impressions a day on the larger presses, provided the pressrun for each plate is at least 2,000 copies.

To illustrate this point further, suppose that 500 copies of a single-color, same-size line drawing are required. Using the operation times just discussed as a basis, you might come up with the following estimate:

Operation	Time
Administration and routing	15 min
Negative making (assuming chemicals were prepared during administration time)	15 min
Opaquing and retouching	15 min
Stripping	15 min
Plate making (presensitized plate)	15 min
Press makeready	15 min
500-sheet run	10 min
Total production time	100 min
25 percent allowance for contingencies	25 min
Total time estimate	125 min

Cold-Type Composition

Estimates for cold-type composition depend on the kind of machine used, the speed of the operator, and the nature of the copy—whether it is justified or unjustified and whether it consists of straight composition or forms. It is estimated that a skilled typist who is acquainted with the machine can type 40 to 45 words per minute when following estimates as necessary to your particular shop:

Operation	Time
Setting up the machine	5 to 10 min
Typing unjustified copy (6,000-8,000 characters)	60 min

SHOP LAYOUT (E-6, E-7)

The chances are that your shop layout was arranged long before you took over. However, to make sure that all operations are functioning properly, you should analyze them occasionally to see if each step gives you the most efficient use of space and equipment. If you believe that you can plan a better layout, you should try to effect the necessary changes by working through the proper authorities.

To be effective, you must properly arrange the equipment. This saves wasted motion and reduces walking distance. This enables your personnel to turn out more work in a shorter length of time.

Work operations should be planned to follow one another in a logical sequence through your lithographic shop. Each step should bring the job progressively closer to the bindery area.

Aboard ship, of course, space limitations and consideration of the motions of the vessel, i.e., pitch and roll, frequently dictate layouts in which convenience and sequence of operations have to be subordinated.

ROUTING WORK THROUGH THE SHOP (E-6)

In shore station lithographic shops, there may be an office and a separate room for each department (fig. 17-10). In such a case, the job is generally planned in the office and then sent to the copy preparation department where it is typed or ruled up, artwork is done, and the copy is pasted up for the cameras. The copy preparation room is generally close to the office. This is because copy preparation is logically the second step in routing work through the shop and also because questions often arise during the preparation of the copy. Since it is easier for the copy preparer to consult the office regarding these matters if the two departments are close together, the copy preparation is sometimes done right in

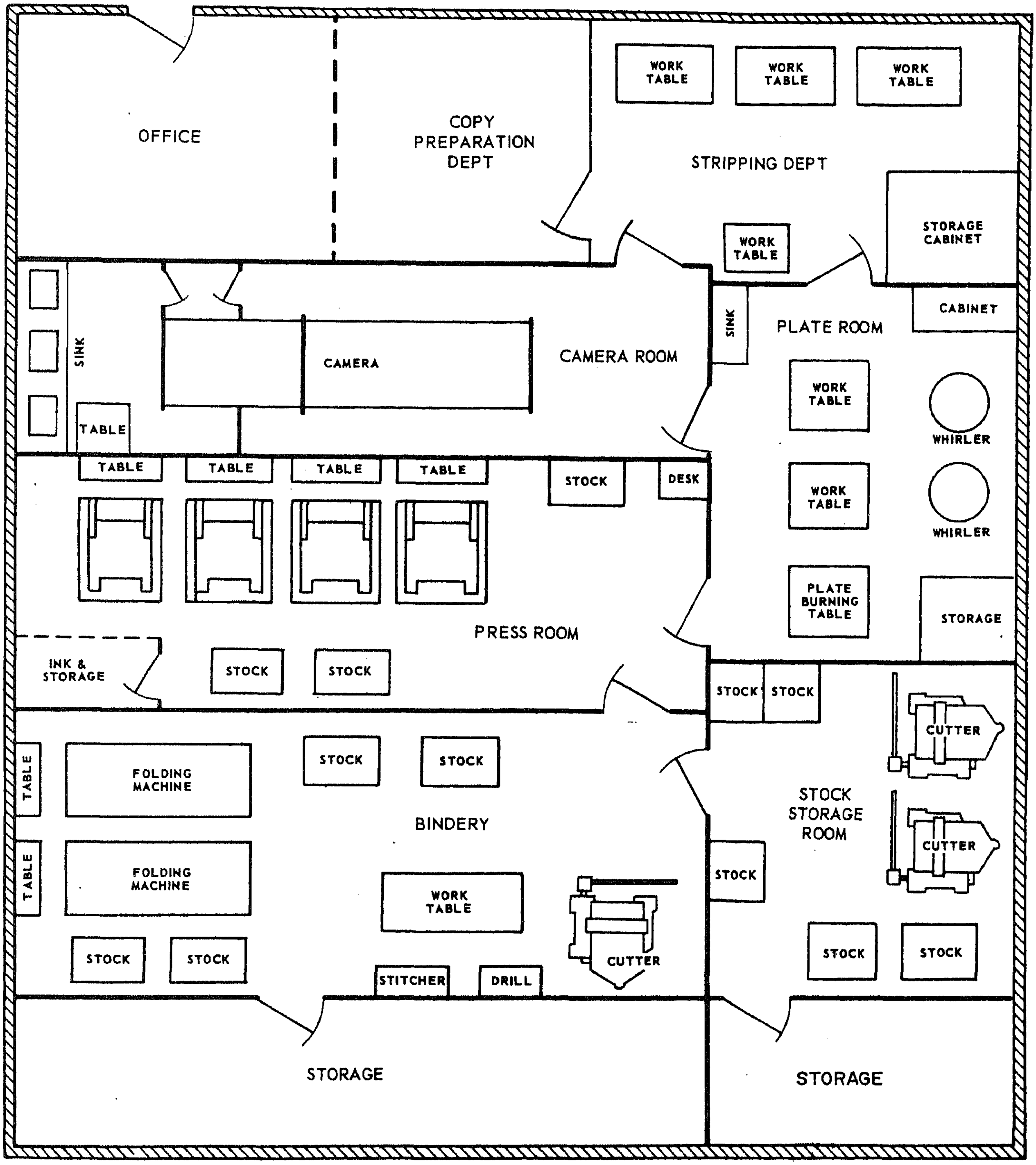

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Figure 17-10.—A possible layout for a lithographic shop at a shore establishment.

The process camera room should also be located fairly close to the office, because the copy normally flows from the copy preparation department to the camera room. Here again, the camera operator may have occasion to consult the office or copy preparation department regarding various aspects of the job.

The stripping and plate-making rooms should be placed somewhere between the cameras and the pressroom and bindery. The pressroom and bindery are generally located near a wide entrance to bring skids of paper in and out.

JUDGING THE QUALITY OF THE WORK (E-6)

You should check the work turned out by each section in the shop. You must also approve the first proofs when a job is put on the press. Before OK'ing a press sheet, you should check it against the instructions on the job jacket. You should also see that the image is straight and positioned properly on the press sheet and that there are no printing defects. If the sheet is being backed up or if close registration is required, you should check it over a light table.

Check important jobs or long runs several times during the pressrun to make sure that the plate is still printing properly and that the color and position have not changed. Other types of work, such as routine forms, will not require a great deal of attention, but even simple jobs for interoffice use should be straight and readable.

Many supervisors work all jobs up to the sheet size of the smallest press. Then they can run a job on the small press or they can run it on one of the larger presses, singly or in units. Work is generally assigned to the presses according to the size of the job and the workload of the presses, although inking and other considerations sometimes enter the picture.

The good supervisor is always cost-conscious as well as production minded. You should estimate the quickest, the best, and the most economical method for turning out the work in your shop.

Suppose, for example, that you are asked to run 4,000 copies of a single page.

You might have two negatives shot and run this job two up on a 14- by 20-inch press or you might use only one negative and run the job one up on a smaller press, using 8 1/2- by 11-inch sheet.

Running the job two up naturally reduces pressrunning time. However, there are other factors which you must consider. If you use the small offset press, you will need only one negative and a small plate as compared to two negatives (or one negative and a double burn) on a larger, more costly offset plate. The type of paper used in running the job two up may also be more expensive then the standard precut 8 1/2- by 11-inch stock. In addition, there is the time involved in making the extra negative or printing

The old saying "time is money" holds true in the Navy as well as in civilian lithographic shops, but you must weigh one factor against another and get the work done in the most economical as well as the quickest way. Think economy and your personnel will think the same.

SUMMARY

Designated sections of this chapter contain information required only for LI1 and LIC candidates. The section titles will be followed by parentheses enclosing the paygrade which that section applies. LI3 and LI2 candidates DO NOT have to read these designated sections. However, junior LIs serving as LPOs may find the information of interest.

The administration of a lithographic shop whether at sea or ashore will be on the shoulders of the senior person assigned. It is, of course, impossible to cover all information you would need to carry out the assigned duties and responsibilities in this chapter. However, the information presented here should help you in gaining a broad understanding of what is required to organize and manage your shop.

This chapter contains the basic rules and regulations as established by the Joint Committee on printing. These regulations are stated in a booklet called *Government Printing and Binding Regulations*.

To back up and rework these regulations to fit the Navy establishment, the *Department of the Navy Publications and Printing Regulations*, NAVSO P-35, was written. This publication is periodically updated by the administrative assistant of the Secretary of the Navy's Office.

An organization, known as the Navy Publications and Printing Service (NPPS), exercises technical direction to Navy Lithographers and for their shops. This chapter outlines the services provided by NPPS as well as the instructions which they publish to establish guidelines. Also other Navy notices and instructions pertaining to the Navy Lithographer and the shop were presented.

Some of these notices and instructions deal with types of unlawful printing such as counterfeiting, fraud, and the use of copyrighted material. The areas were discussed in detail to aid the Lithographer in the required administration of the lithographic shop.

Since the Navy Lithographer is often required explained the required handling of this material. This chapter also dealt with the category titles and their definitions. How classified material is prepared and marked by the government and the Navy as well as the required accountability and access requirements were presented.

Several different levels of security clearances for Navy Lithographers are available. Therefore the required steps and security investigations to obtain these clearances were presented in this chapter.

As the Navy Lithographer does his work producing classified material, some classified waste (trash) is produced. This classified waste must be disposed of in the proper manner to assure its total destruction. In this chapter, you were told the methods, checks, and records necessary in the completion of the destruction of classified material.

The lithographic shop needs to keep not only records of classified material but also files of their negatives and printing logs. These files and logs should be kept simple, but they should contain enough information to give you a complete picture of the jobs in your shop and provide you with data on which you can base your supply requirements.

The Navy Lithographer has a required responsibility to the equipment in the area of maintenance. This maintenance should include both preventive and corrective maintenance. To help in the completion of this responsibility, the Navy uses the Ships' Maintenance and Material Management (3-M) System. This system provides for the orderly scheduling and completion of maintenance. Therefore, you should become familiar with the Ships' 3-M System.

Man-hour reporting is an area in which more records must be kept by the Navy Lithographer. For example, aboard tenders and repair ships, all work hours for each person must be recorded and turned in. These records also will include information on material expended, costs, work delays and stoppages, and so forth.

You may have a requirement to originate or reproduce a form of Navy correspondence. This correspondence may be in the form of either a standard Navy letter, memorandum, or message.

Supplies are, of course, an important area of concern for the Navy Lithographer. This is because these supplies must be on hand when needed or you cannot do your job properly. Supply duties will vary from Lithographer to Lithographer; in the shop, however, they are all important. Here, in this chapter, the duties and procedures have been present to aid you in the completion of your supply duties.

The Navy Lithographer uses the Joint Committee on Printing (JCP) Form No. 5 to record and report shipboard inventories of equipment. An initial form has already been submitted if your ship has not just been constructed or refitted. After submission of the initial form, another must be prepared and submitted annually within 10 working days of the end of each fiscal year.

In your lithographic shop, you will have the occasion to either review or make out work requests for your customers. You must ensure your customers that when you take on a job that you have all the information necessary to complete it as the requirement demands. Also the work request must include the required signatures and security classification markings. Some shops keep track of the work in progress on control cards.

There will be times when you will have to make estimates in advance of the time required to complete a job. While lithographic shops differ in equipment and personnel, a set of standard times can aid you. These standard times were presented in this chapter. Of course, you may have to adjust these figures to fit your own shop.

When the equipment is arranged in the shop layout plans, you should take into consideration the logical movement of the job through the shop. As a rule, the lithographic job starts at the office or front desk and moves through copy preparation, camera, stripping, plate making, presses, and the bindery. However, you may have to make alternations to your thinking because of the area you have for the equipment and/or the location of the shop aboard a ship.

During the progress of a job through the shop and up to its completion, the quality of that work must be checked to assure the best possible job. Work of the Lithographer should be professional and it should be completed in a timely manner.

The techniques of supervision will be discussed in the next chapter.

CHAPTER 18

TECHNIQUES OF SUPERVISION

This chapter mainly contains information required for LI1 and LIC candidates. LI3 and LI2 candidates DO NOT have to read this information. However, junior LIs serving as LPOs may find the information of interest.

As a first class or chief petty officer, you cannot concern yourself with just one kind of equipment. You will be expected to do more than perform the duties of lower rated personnel. With advancement, you take on supervisory duties. You will be directing others in what to do and how to do it. You will need to know how to direct your personnel to get the most out of them. You must be able to plan jobs and make estimates, foresee difficulties and devise methods of overcoming them, and set up training programs. You must be safety conscious, making sure your personnel work safely at all times. You must be able to "bring it all together" and make your shop personnel work as a real team.

SUPERVISION

Supervision is probably more of an art than science. Supervisory techniques that work well in one situation may not work in another. However defined, supervision simply means overseeing and directing the work of others. Although supervision is related to and extends into management, you need not know the distinction between them. You should concern yourself with what is generally included in supervision—organizing, delegating, coordinating, checking personnel and equipment, eliminating bottlenecks, and more.

ORGANIZING

As a supervisor, you must be able to ORGANIZE. In doing so, you study the situation and plan the steps that should bring about desired results. Suppose you are given a ship's newspaper with photographs. You should first look at the job to be done and estimate how many man-hours are required to complete it. You will probably have been given a date by which the job is to be completed. Next, plan the sequence of in-shop lithographic operations needed to complete the job. To do this, think about how much copy preparation and halftone work is required. Are the halftones to be enlarged or reduced? Are there likely to be photographic problems? What equipment is available, and what is its condition? Is it likely that you will have to request additional help? For instance, do you need drafting or photographic assistance from outside your lithographic shop or a working party for the finishing or gathering operation?

You must pay special attention to the ability of your personnel. Are they experienced in halftone photography? Will training be required before they can operate equipment? Are any of them scheduled to be away from the shop for any reason such as leave, TAD, etc.? Will you need to request additional personnel? After getting answers to these and other questions, you should be able to assign your personnel accordingly and set up tentative schedules. If work shifts are necessary, arrange for the smooth transition from one shift to another with a minimum interruption of work flow.

DELEGATING

In addition to organizing, you, as the supervisor, must be able to DELEGATE the work in your shop. Failure to delegate is a common fault among new supervisors. It is natural to want to carry out the details of the job yourself, particularly when you know that you can do a better and faster job than any of your Lithographers. Trying to do too much, however, is one of the quickest ways to get bogged down in details and slow down the large overall operation. Obviously, you cannot be in two places at the same time. There will be times when personnel need help or instruction in solving problems. If they have to wait until you are available, when you are busy or away from the shop, then valuable time may be lost. You should deputize one or more of your personnel to delegate authority and make decisions in certain matters. In these cases, you must know who the responsible personnel are and who can make sound decisions in the areas where you have delegated your authority.

COORDINATING

Your ability to COORDINATE operations is still another important characteristic of a good supervisor. When several lithographic shop operations are in progress, one must dovetail into another to prevent interruption of the work flow. An example of coordination is being sure a press operator has enough cut paper stock available to support the presses production run on a continuing basis.

You should make certain that all members of your lithographic crew understand their work assignments—WHAT they are to do and WHEN they are to do it.

CHECKING PERSONNEL AND EQUIPMENT

One of the most important duties of any supervisor is to keep a constant check upon the personnel and equipment. In carrying out this duty, asking yourself the following questions while you make your inspections will be helpful.

1. Are your plans and the job specifications being followed?
2. Is the equipment being used efficiently?
3. Is each person giving his/her best effort?

You can answer these questions by simply walking around the work area and watching. When you have many pieces of lithographic equipment and a large number of personnel, it may be useful to make a checklist on paper to help you answer these and other questions.

You may need to prepare a checklist for each type of equipment, based on its operational characteristics and possibly the recommendations of the manufacturer. It might also be useful to make a checklist for the personnel operating the equipment. Questions you need to keep in mind are as follows:

1. Are they reporting on time?
2. Are they using the proper operational procedures?
3. Are they servicing the equipment properly?

ELIMINATING BOTTLENECKS

Part of your job as a supervisor is to spot causes of delays and eliminate them. Every lithographic job could develop its own special problems, and your imagination and ingenuity will determine how a particular problem is to be solved. Shifting equipment or personnel around or adding equipment (such as a second press to increase the efficiency of the press operators) could be a possible way to eliminate bottlenecks.

JOB CONTROL

The planning of the day-to-day job assignments for personnel can be a frustrating job unless you are thoroughly familiar with the capabilities of your shop personnel and equipment. This is particularly true during deployment where the priorities of the shop personnel may be subject to daily change because of workload or location.

By knowing your personnel and their capabilities, you should be able to control the job assigned and the additional ones that arise due to an emergency situation by

1. planning work to best use your existing manpower;
2. making sure that each step scheduled for the job is really necessary, eliminating or combining operations when possible;
3. deciding the priority of jobs and having second or third priorities in mind so that personnel and equipment can shift jobs if delayed on a primary project;
4. insuring that all required tools, equipment, and repair parts and supplies are on hand;
5. determining types of skills required for the different jobs necessary to perform the operation of your shop;
6. determining how many hours a particular job should take to complete in your shop under normal or adverse conditions; and
7. conducting inspections of your equipment and personnel while the work is in progress and upon completion of the job.

MAINTENANCE OF EQUIPMENT

If maximum job production is to be achieved, each piece of your equipment must be kept at peak operating condition. Except when shift work is required, each piece of equipment should be assigned to one individual operator. This operator has the responsibility for the daily and weekly equipment. You must explain and point out this fact to each operator, making sure each one understands. If more than one operator is assigned to a piece of equipment (for example, when you are operating on shifts), you must be sure each operator of that particular piece of equipment for that particular shift is responsible for daily and weekly preventive maintenance. You must also arrange for close liaison with the maintenance personnel who will handle repairs that are beyond the duties of the operator.

INSTILLING MORALE

As defined here, morale concerns the mood or spirit of an individual or a group with respect to performance of their duty. High morale is necessary for you to obtain maximum work output over a period of time.

Don't be mislead into accepting that morale will be high among the personnel in a work center if you allow them to report for work late, not do their share during working hours, use their equipment carelessly, or stop work early. Should you allow this, their morale is bound to suffer and so will job performance.

Fairness in dealing with your personnel is necessary to obtain a high level of morale. Individuals must see and understand that everyone is being treated fairly and equally and that some are not being required to do more than their fair share of work.

Personnel are extremely sensitive to partiality by a supervisor. For this reason, you should think ahead about changes, decisions, work assignments, and the like.

In making a decision that only one person is happy with, it seems wise to ask yourself, How will every other individual in my unit feel about the decision?

Good working conditions are also important for a high level of morale. With this in mind, try to make working conditions as comfortable as possible for your personnel.

Impress upon your personnel the importance of their individual work assignments and how these assignments fit into the shop's overall mission. Competition against a time schedule might be useful in promoting high morale. As a supervisor, you should try to give your personnel a sense of accomplishment by letting them know that you appreciate their hard work and an all-out effort in turning out a good job. Make them proud to be a lithographic shop team member.

You can solve the personnel replacement problem by rotating the work assignments so that each of your personnel will have a chance to learn the skills of the others. Work rotation is a time-honored tradition of the printing trade. The word *journeyman* sprang from the rotation system. The early printshops were limited in equipment, and it was necessary for an apprentice to work in shops in several different cities to obtain a well-rounded printing background. After the individual had worked in three or more shops, he was considered a skilled printer. He was called a ''journeyman'' because he had traveled from one town to another in acquiring this experience.

Work rotation still plays an important role in providing a person with a well-rounded background. So rotate assignments. Don't keep one person on the press all the time. Shift them to the camera or the plate-making section when possible. Let all the personnel have a crack at each operation. This will give your personnel more knowledge and experience and enable them to advance more rapidly. You and your shop's operation will also benefit. If your best camera operator is transferred, you won't have to break in a new replacement. You will already have an experienced replacement available.

EARNING RESPECT

Respect must be earned. You can't win it by flattery, apple-polishing, throwing your weight around, avoiding issues, or striving for popularity. In supervising your personnel, create an atmosphere in your shop of courteous and helpful direction. The less noise you make, the better will be the results. There is no room for the ''Do as I say, not as I do'' approach. In today's technical and ever-changing Navy, the need is for personnel who lead with intelligence, by know-how, and by good example. Good supervision produces a smooth-running organization; poor supervision creates confusion and dissatisfaction.

TRAINING

The training program of each division should provide personnel with the skills needed to accomplish the command's current mission. The program should be crafted according to the pattern, priorities, and tempo established by the commanding officer. The training program should cover many phases, from orientation courses to special technical courses. The program depends upon such factors as operational commitments, policies and directives from higher authority, experience and previous training of the personnel, and training facilities available.

Training must be closely integrated and coordinated with daily operations of the command. The plan and organization for training that is adopted must not interfere with the essential lithographic production. Nevertheless, the training schedule should not be so rigid that it overlooks opportunities for training that may expedite the mission. Full advantage should be taken of the training opportunities that routine operations are likely to present.

Training New Personnel

You should train personnel in your lithographic shop to be careful when they are working around moving lithographic machinery or with toxic chemicals. Practice safety first and last. That's good advice and you should emphasize it to your personnel. Always explain safety precautions so they will see the need for them. Don't under any circumstances let a safety violation go unnoticed or unchallenged.

It is also a good idea to establish some kind of system for automatically replacing ill or injured personnel as well as for continuing operations despite equipment breakdowns and shortages of supplies.

You cannot overemphasize the necessity for required safety precautions to your personnel. Personnel who are new at operating lithographic equipment sometimes find it hard to realize the danger in all those moving parts, and it is not possible to show by demonstration what can happen if a finger gets in the wrong place and the gears cut it off. Then, too, personnel who have been operating the same piece of equipment for a long period of time often become overconfident and become careless in the use of the equipment.

Training Needs

A study of the job-related skills required to do a particular job will be the starting point for training. After you have made this study, take inventory of the skills the personnel in your shop already possess. You can easily see whether the required skills match the available skills. If they do not match, this is a good indication that some training is needed to bring the personnel up to the desired level of proficiency. In some cases, you will need to conduct refresher training; in other cases, you will have to give instructions on new techniques.

One of the most useful things you can learn about lithography is how to find out more about it. You should learn where to look for accurate, authoritative, up-to-date information on this subject.

There are various government publications you may find useful as sources of reference in addition to those listed throughout this manual. Additionally, there are trade books and magazines which will contain information that will help you in your work of learning and training.

On-the-Job Training

On-the-job training will probably be your most common training responsibility as a supervisor. Therefore, you must be equipped to assume the responsibility of training your personnel on the job. Of course, you should start your personnel out on the simplest jobs and work up to the more complex jobs.

On-the-job training plays a major role in the development of highly skilled Lithographers and equipment operators. Nothing is a suitable substitute for experience.

When the desired level of proficiency has been reached, training should be directed at broadening individual and team capabilities.

Insofar as practical, you should attempt to rotate your personnel to the various jobs involved in the normal shop operations so as to provide them the opportunity to broaden their individual lithographic capabilities. Training for your senior petty officers should include provisions for becoming familiar with the general aspects of the other media ratings. (This is called cross training.)

Empathy is a much-needed quality in discharging your training responsibility. Good supervisors have the ability to put themselves in the shoes of their personnel; there you can see their needs and to understand their fears and tensions. The ability to empathize will help you recognize the anxiety experienced by new operators, who are in the work area for the first time in new surroundings, and meeting new fellow operators. Empathy will help you see the job from the operator's viewpoint rather than through the eyes of one with years of experience and familiarity with the operation of the shop and equipment.

As a rule, your personnel will be eager to learn, and they should be given every opportunity to learn all they can. Get your personnel together in a group for instruction as often as possible. Even your best personnel can learn more about their jobs. Tie their work and training together. Use your skilled personnel to train the others in your shop. Pair the untrained personnel off with some of your more experienced operators. Keep every person learning and you will have a wide-awake team ready to meet any situation.

There may be times when the personnel in your shop will be required to work 12 to 16 hours a day to complete priority jobs. At other times, you will have nothing but routine work for several days at a stretch. Periods when routine work is in progress is the best time to train your personnel or to make changes in working procedures. This gives personnel plenty of time to grasp new ideas. During slack periods, when the equipment in the shop is not required for the regular work, you should assign practice jobs to your strikers and lower rated personnel.

Instruct your personnel one step at a time. Don't confuse them by giving them too much information at once. Don't skip over any of the steps or try to teach shortcuts. Teach only safe and sure steps and methods. You should always stress the need for quality in production.

New personnel must be trained properly from the start because it will be difficult for them to change their working habits once they have them fixed in their mind. Always teach them the safety rules before you allow them to operate any piece of equipment. Then safety will fit into their good working techniques. Be sure they have learned the fundamentals of the job before you turn them loose on their own. It is a good idea to divide your instruction between practice and theory. Tell them why, show them how, then give them a chance to try it.

When you let inexperienced people do a new task, keep an eye on them, but don't butt in or take-over when they make their first mistake. Stop them and explain the error. Then let them correct the mistake themselves. Right from the start, teach your personnel good working habits, such as cleaning and lubricating their equipment and putting their tools away after work. Pay particular attention to the training of persons who are weak in one or more phases of the work. If they lack skills in certain operations, allow them to work at those operations under the guidance of a more skilled operator.

Make It Interesting

Lithography is not only a fine profession, it is an interesting hobby. This is evidenced by the fact that the country is dotted with hundreds of basement printshops which people operate as an avocation. And this brings up an important point. Good Lithographers enjoy their work. To them, it is more than a job. You should build up this enthusiasm for the work in your shop and pass it along to your people. Encourage them to use part of their spare time studying books and magazines on printing and lithography. Set a good example for them by keeping up with all the latest information about the equipment in your shop and with new developments in the lithographic field.

At the end of this chapter, there is a list of a number of good commercial books on printing and lithography, as well as some leading trade magazines. You can generally find these publications at any public library or lithographic supply house.

The More They Learn, The More They Earn

You can give your personnel an incentive for learning by showing them how they will benefit from their training. Make them realize that learning new skills will give them a feeling of accomplishment and earn them respect from their shipmates. It will also help them to get a higher rate at advancement time. Develop a spirit of working together and your personnel will do wonders both for themselves and for your shop.

Be consistent and reasonable. Give your personnel a sense of security—a feeling that they will know just what to expect of you. Describe precisely what you want them to do so there will be no misunderstanding. Praise good work and correct poor performance without causing hard feelings.

New personnel must be given some idea of what is expected of them when they have completed their training period. This will make them aware of specific goals and give direction to their efforts.

You should set quality standards at an appropriate level and ensure that your personnel are acquainted with them and then trained to achieve them. Occasionally, you will come across a person who wants to defeat them. You should assign this person a reasonable but specific amount of work each day and see that it is done.

You should make sure that all of your personnel know that the responsibilities of each person in the shop is clearly defined. Several people may use the camera, small offset press, and so on, during the course of a day, but only one person should be responsible for the maintenance of a particular piece of equipment. You should also assign one person to maintain each of the physical areas of your lithographic shop. Little things mean a lot to the efficient operation of your shop. Loose paper lying around the pressroom is not only unsightly, it is also a fire hazard and can be dangerous to the press operator. Similarly in the darkroom, keep bottles tightly covered to prevent spillage, to prevent evaporation, to keep out dust, and so on.

Formal Training

Formal training is, in general, training that goes on outside normal working hours or during periods of enforced nonwork; for instance, inclement weather. Such training usually takes place during regularly scheduled training periods and is often conducted in groups. Participation may or may not be voluntary.

There is no "best" method of formal training that applies to every situation, although the lecture-and-demonstration method is most common. Use the method that best fits the training situation. Apply as many good teaching practices as possible. For one, make sure your material is complete. Do not leave out steps or significant information. Arrange your material in a systematic and orderly manner so that each step rests securely upon the information already provided. Avoid overlapping since too much repetition is a waste of time and usually leads to inattention on the part of the trainees. At the same time, impress upon them the importance of using the correct terminology and/or technical language common in the LI rating. In so doing, your personnel should learn more readily and also retain a more detailed picture of the functions and operations of their job.

Subject matter may be classified as knowledge type, attitude type, or skill type. Knowledge-type subject matter is taught to build up a store of useful facts, principles, theories, and so on. Skill-type subject matter, mental or physical, is taught for the purpose of helping one acquire the ability to perform a job with ease, speed, and precision. Attitude-type subject matter is taught for the purpose of creating proper feelings, understandings, respect, and the like.

SUMMARY

While this chapter is primarily directed to the LI1 and LIC candidates, junior LIs serving as LPOs may find the information of interest. The last section entitled "Sources of Information" is mainly directed towards the LI2 candidate.

As a LI1 or LIC, supervision of personnel becomes more and more important to you as a Lithographer. You need to consider such elements such as planning jobs, making estimates, foreseeing difficulties, and training your shop personnel. You must be able to "bring it all together" so that your lithographic shop personnel work as a team.

Supervision is an art and not really a science. A supervisor oversees and directs others. To do this, you will need to organize. Here, the first step is to study the situation and collect all the facts you can. Then you will be able to make decisions so that your organized plan gets the desired results.

Delegating work is a hard skill to develop because it is sometimes much easier and quicker to do the task yourself. However, like organizing, the supervisor must delegate the jobs and sometimes your authority. This helps your junior personnel learn.

As you coordinate the shop operations, you are showing another important characteristic of a supervisor. Different lithographic shop operations going on at the same time can and should compliment each other so that they work to help each other in the completion of the shop's mission.

Another of your duties is to check not only your personnel but also the equipment on a regular basis. It is a good idea to write things down as you do these checks so that details are not forgotten.

Sometimes bottlenecks or delays will develop. Of course, it is the job of the supervisor to determine the required solution and eliminate them.

A supervisor must know his personnel, their skills, and the capabilities of the shop. Then you can truly control jobs as you plan how they will be completed in your shop.

For maximum job production, your equipment must receive the required maintenance. Your shop personnel must understand the importance of this maintenance and their duties connected to its completion. You should also develop a close liaison between yourself and the equipment repair people who can do repair work beyond the abilities of your shop personnel.

You can create a high degree of morale in respect to your personnel's performance of their duty. This is accomplished by dealing with everyone in your shop fairly and equally. Also personnel in your shop should be told the importance of their work and how they fit into the whole operation. You should also give praise to your personnel for work well done to help in developing good individual or group morale.

You should rotate the assigned jobs in your lithographic shop. Then, not only will your personnel improve and broaden their lithographic skills but your shop will be more efficient. The efficiency of your shop's production will increase when your personnel are able to do the jobs of others. With these new skills, they can fill gaps created by personnel who are absent from the shop.

The only way to get the needed respect of your personnel is to earn that respect. You should create an atmosphere in your shop of courteous and helpful direction. In this atmosphere, you can produce a smooth-running organization.

Of course, it will also be the supervisors responsibility to ensure that the personnel assigned are trained. Safety is a very important factor in the training of new personnel because the correct work habits learned from the start will be remembered best.

By knowing the skills of your shop personnel and the skills needed to complete a job, you will be able to see where additional training is needed. Also as new methods and equipment are introduced into the lithographic field, you will need to see that your shop crew is kept current.

Training can easily be conducted as on-the-job training. In other words, your shop personnel learn as they do the day-to-day work. Of course, new personnel must be started out on the simpler lithographic jobs. Safety and quality in production should be stressed from the start of training.

The training should be kept interesting. It will be interesting if you build and encourage interest so that your personnel can learn to enjoy their work. With a good training program, your personnel will learn more about lithography and therefore advance in rating faster. So set quality standards at appropriate levels and ensure that your personnel are trained to meet them. Not only is this the supervisor's responsibility, but it will create a more efficient lithographic shop operation.

Formal training differs from on-the-job training in that it is not usually conducted during normal production time. This training is normally conducted in group sessions and any type of information could be passed on to the group. However, it is important that you be completely prepared before starting such a training session.

The next section of this manual contains an additional reference reading list.

CHAPTER 19

PHOTOGRAPHIC PROBLEMS

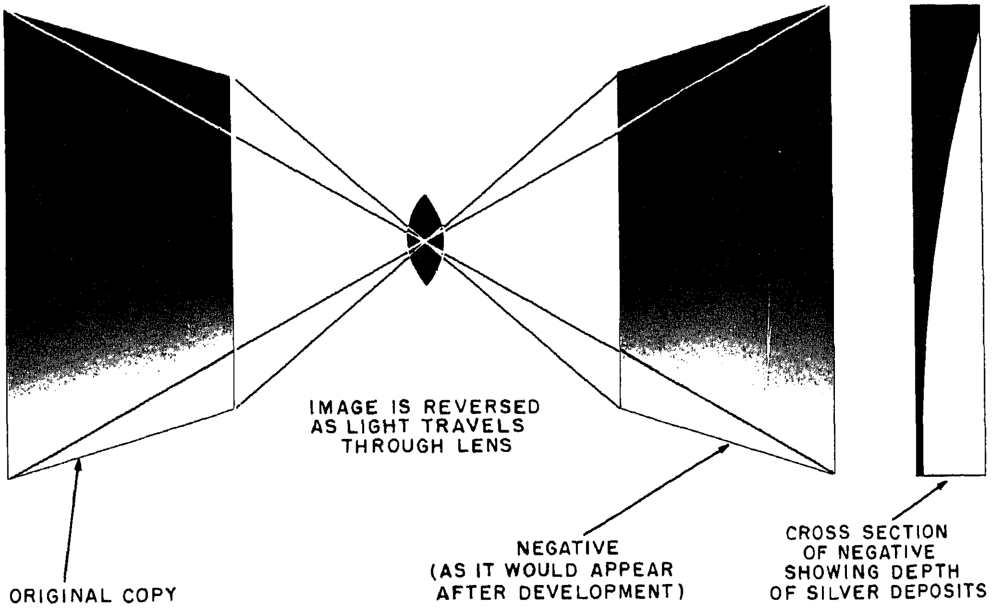
IMAGE IS REVERSED AS LIGHT TRAVELS THROUGH LENS
ORIGINAL COPY
NEGATIVE (AS IT WOULD APPEAR AFTER DEVELOPMENT)
CROSS SECTION OF NEGATIVE SHOWING DEPTH OF SILVER DEPOSITS

113.66

Figure 19-1.—The tones in a continuous-tone negative vary with the amount of blackened silver on the film. During the exposure, the light first enters the film emulsion at a point where there are slight surface irregularities. And if there is enough light or if the exposure is long enough, the light will eventually work its way down to the base of the film. Since more light is reflected from the brightest parts of the subject or copy, the light from these areas naturally penetrates deeper into the emulsion than the light reflected from the shadow and gray middletone areas. As a result, when the film is developed there are heavy deposits of silver in areas that were struck by strong light reflections and thinner deposits—even transparent areas—in places where little light struck the film. The emulsion on photographic paper is similar to that used on the film, so the same thing occurs when the film is printed on the paper. This explains the gradation of tones in photographic prints.

This chapter mainly contains information required for LI1 and LIC candidates. LI3 and LI2 candidates DO NOT have to read this information. However, junior LIs serving as LPOs may find the information of interest.

Although people had been studying the effects of light on silver salts for many years, photography had not been invented when Joseph Niepce produced the world's first photoengraving in France in 1824. Niepce did not have a negative, of course. Instead, he used a proof taken from an original engraving to obtain the image. He printed this image on a metal plate (coated with a solution of asphaltum) by exposing it to the sun for several hours. Since he was printing from a positive, he produced a reverse image on the plate. When he etched the image into the metal, he produced an intaglio (engraved) image rather than one that stood in relief.

FIRST PHOTOGRAPH

Niepce's son later joined in photographic experiments with L. J. M. Daguerre who was trying to develop continuous-tone images (fig. 19-1). Finally, in 1839, Daguerre produced the

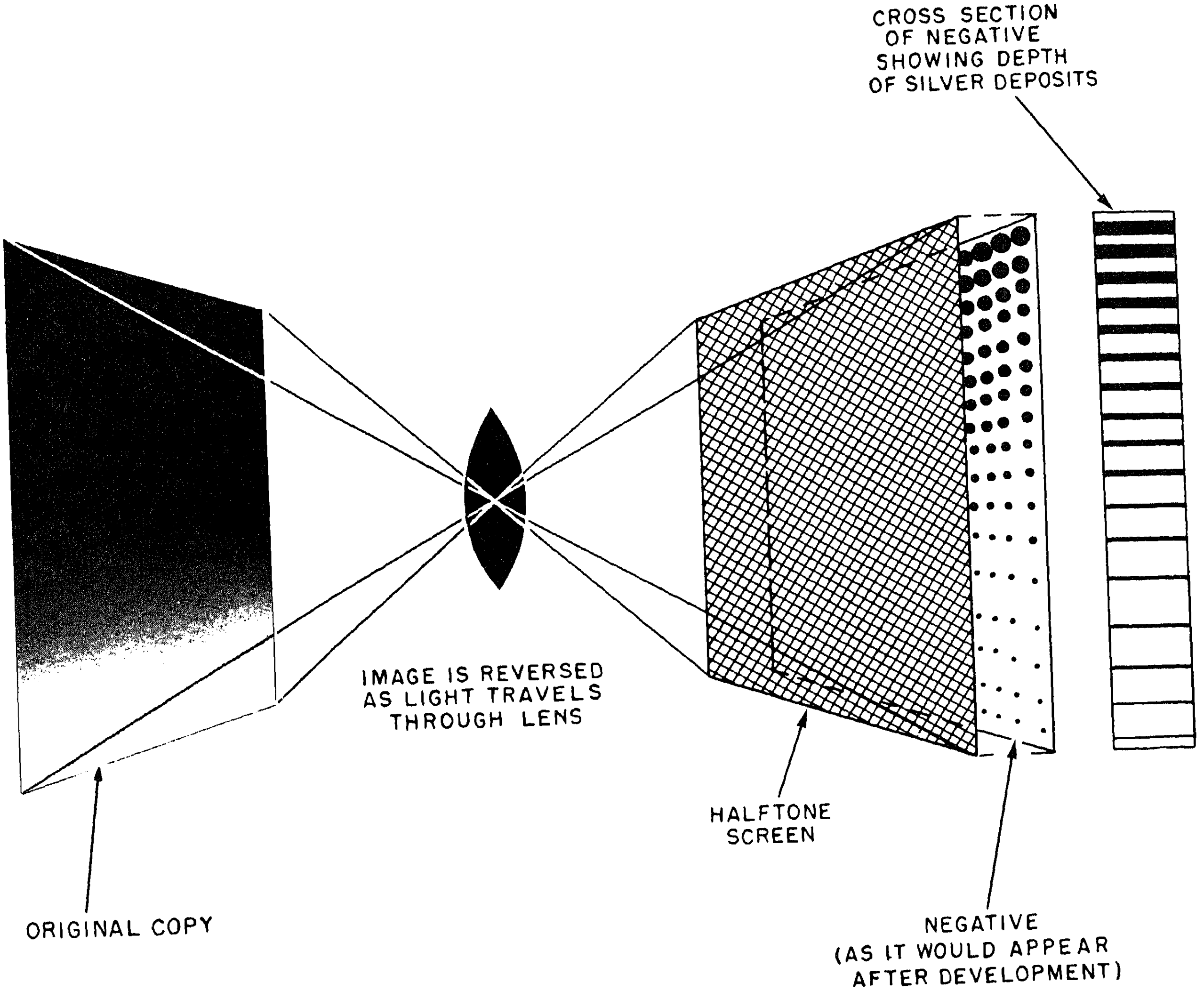
CROSS SECTION OF NEGATIVE SHOWING DEPTH OF SILVER DEPOSITS
IMAGE IS REVERSED AS LIGHT TRAVELS THROUGH LENS
HALFTONE SCREEN
ORIGINAL COPY
NEGATIVE (AS IT WOULD APPEAR AFTER DEVELOPMENT)

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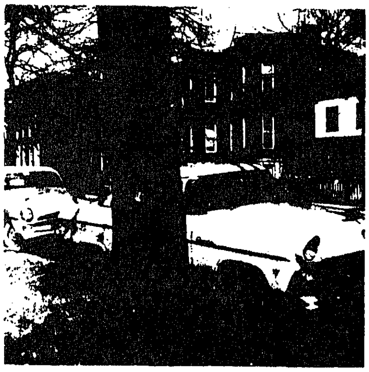
Figure 19-2.—Each of the openings in the glass halftone screen acts as a tiny pinhole lens, projecting the light onto the film at the back of the camera. Strong reflections from the highlights of the copy pass through the openings in the screen and fan out on the negative to produce large, black dots. But the weaker reflections from the shadow and gray middletone areas form smaller dots. When the film is developed, the image consists of a series of dots varying in size, according to the brightness of the original copy, but all having great opacity. And when the film is printed on the plate, these dots actually print as line; that is, as tiny black solids. But since the dots are so small, they blend together to give the eye the impression of continuous tone.

first successful photograph, which he called the Daguerreotype.

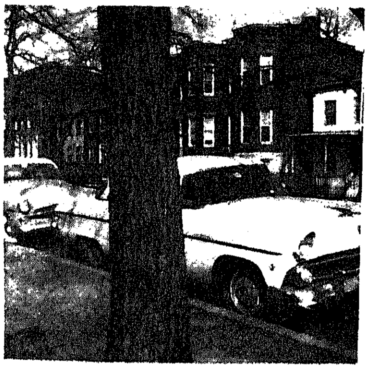
Twelve years later, F. S. Archer, an Englishman, devised a method of stripping the emulsion from a photographic print. It could then be used as a negative for direct printing on metal. The following year, H. F. Talbot, another Englishman, discovered the first suitable light-sensitive coating for metal plates. He found that certain organic solutions become water insoluble when

From that point on, it became relatively simple to print line negatives on metal plates and lithographic stone. But tone images presented a different problem because the coating used in sensitizing the plates or stone was tone deaf. It registered only solid blacks and whites and dropped out the gray middletones of the original copy (fig. 19-2).

Even if it had been possible to print continuous-tone images on press plates, the results would have been disappointing when the job was



PROOF FROM PLATE MADE
WITH CONTINUOUS TONE NEGATIVE



PROOF FROM PLATE MADE
WITH HALFTONE NEGATIVE

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Figure 19-3.—When the coated plate is exposed to light through a negative, the parts of the coating struck by the light are hardened and become insoluble. But the portions of the coating that are protected from the light by the opaque portions of the negative remain soluble and wash off the plate during development. Line and halftone negatives can be printed on the plate with excellent results, but continuous-tone negatives cannot be used because the gray middletones shut out part of the light and prevent it from hardening the coating in these areas. As a result, these partially hardened areas soak off the plate during development, carrying away most of the middletones and detail. If the plate is burned sufficiently to harden these areas, the light penetrates the negative and the intermediate shades go black, as shown here.

run because the press prints only solid colors. The press inks all parts of the image evenly and cannot be set to print grays and intermediate tones in one area and solid black in others. Printers realized that in order to produce these tones, it would be necessary to break the original illustration into a series of lines or dots similar to the woodcuts and engravings of the period.

FIRST HALFTONE

In 1878, Frederick E. Ives, of Philadelphia, succeeded in breaking a photograph into a series of tiny dots by copying it through a halftone screen. When the negative was developed, the image consisted of a mass of dots. These dots varied in size according to the brightness of the original copy, but all had similar opacity. When the plate was made and run on the press, these dots actually printed as tiny black solid lines. But since the dots were small, they blended together to give the eye the illusion of continuous tone (fig. 19-3).

During the next 10 years, people tried various types of screens to improve their halftones. Some used screens of silk or gauze. Others used screens consisting of negatives made from inked lines or checkerboard drawings. Finally in 1890, Max Levy came up with the first diamond-ruled, crosslined halftone screen. It was then that halftone production really got under way.

Although the basic principles of using graduated dots to produce tones on paper has not changed, there have been important changes in materials and equipment over the years.

METHODS OF PRODUCING HALFTONES

Over the years there have been few changes in the procedures for producing line negatives. However, halftone production has undergone a number of changes. Halftones may now be produced with a glass halftone screen, with a contact halftone screen, on Autoscreen film, with a screen inserted in a Polaroid camera, and with photoelectric scanners. The following discussion offers a comparison of the first four methods because they are the methods most commonly used.

GLASS HALFTONE SCREENS

When using a glass screen, the operator may get by with a single exposure and a flash if the original copy is good and has normal graduation of tone. This exposure is generally based on an aperture opening of f/32. However, in most cases, it is necessary for the camera operator to use a series of exposures at different aperture openings

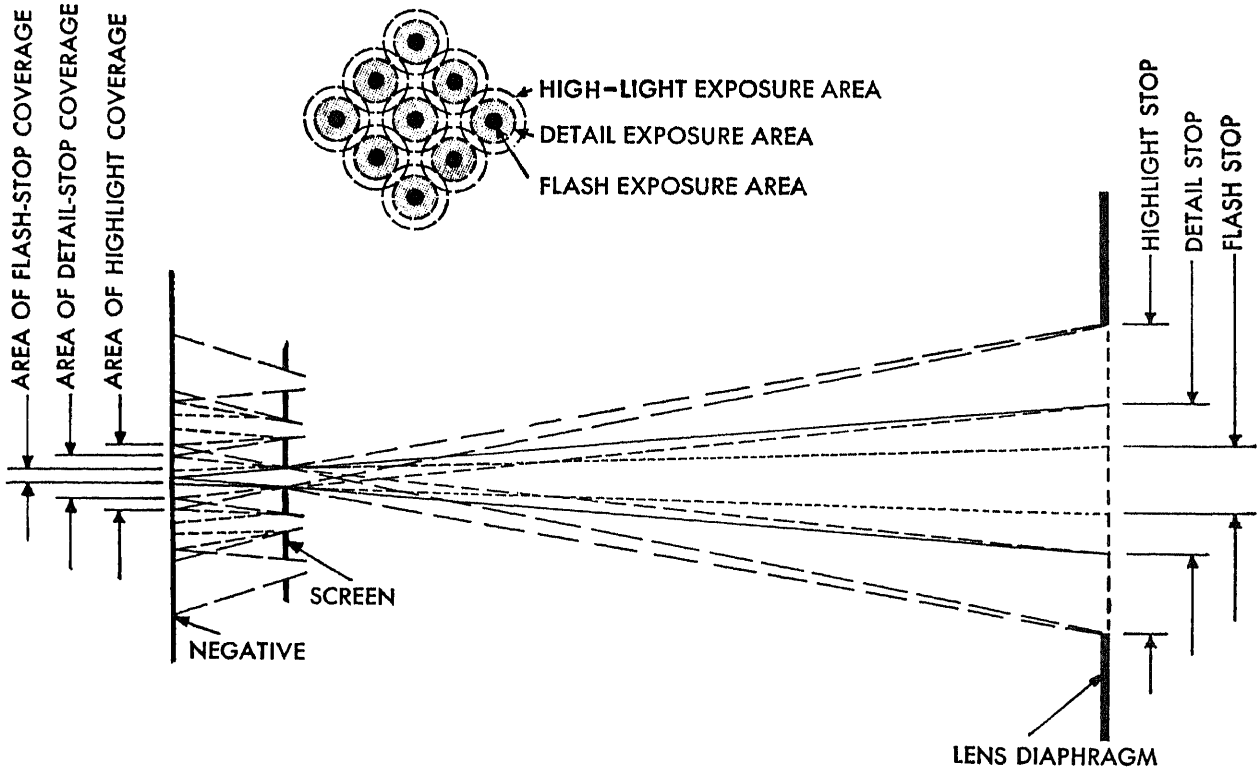

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Figure 19-4.—How the lens opening affects the formation of the halftone dots.

to control the contrast of the negative. Figure 19-4 shows how these multiple exposures affect the character of the halftone dots.

An f/45 aperture opening is generally used as the basis for a detail exposure. This is also usually the setting that requires the longest exposure. It is used to record the detail of the original on the negative. And it does just that. It records all of the gray middletones. But it leaves the shadow areas unexposed with weak transparent dots or no dots at all. It also gives the highlight areas small dots and large, transparent openings.

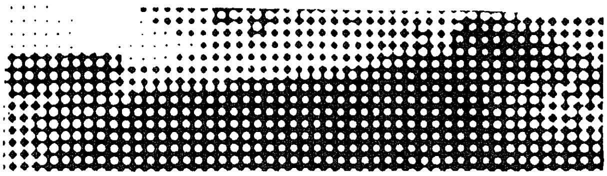
A plate made from such a negative will print the detail of the middletones, but the dark shadow areas will fill in and the highlights will appear dull and gray.

To snap up the printed copy, most camera operators use two supplementary exposures—a highlight exposure and a flash exposure—in addition to the detail exposure.

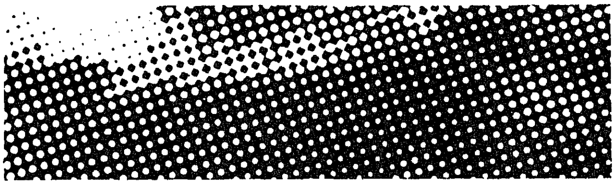
The highlight exposure is generally shot at f/22 for same-size copy. This exposure is used to record the bright areas of the copy and is generally of very short duration. It requires about one fourth as much time as the detail exposure.

Since the highlight aperture opening is larger than that used for the detail, it lets in more light and produces a larger dot. However, the exposure is of such short duration, only the light from the brightest areas of the copy registers on the film. The gray and shadow areas of the copy reflect less light than the highlights, so the light from these areas does not have time to penetrate the film emulsion. Therefore, the highlight dots spread and grow until only a small transparent opening is left between them. Also there is little change in the size or opacity of the shadow and middletone dots (fig. 19-5).

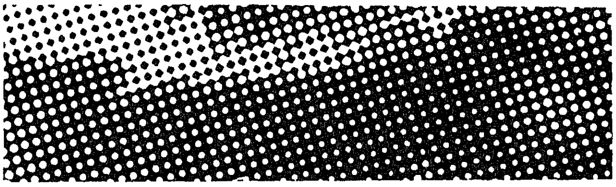
The two exposures take care of the highlight and detail areas, but as you can see in the figure, the shadow areas are still underexposed. They have weak, transparent dots in some areas, and no dots at all in other areas. To correct this, the camera operator uses a flash exposure to increase the density of these dots and to provide dots where none exist in the shadow areas. You should use a small aperture opening, usually f/90, as a basis for the flash exposure. You should cover the copy with a sheet of white paper during the flash exposure. The white paper photographs as a



DETAIL EXPOSURE. NOTICE THAT HIGHLIGHT DOTS ARE SMALL AND THAT DOTS IN SHADOW AREAS ARE WEAK OR MISSING.



HIGHLIGHT EXPOSURE INCREASES SIZE OF HIGHLIGHT DOTS, BUT HAS LITTLE EFFECT ON DOTS IN SHADOW AREAS.



FLASH EXPOSURE BUILDS UP DOTS IN SHADOW AREAS, BUT DOES NOT AFFECT SIZE OF DETAIL OR HIGHLIGHT DOTS.

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Figure 19-5.—Results of multiple halftone exposures.

highlight. But since the lens opening is so small and the exposure so short, the flash exposure produces a very small, opaque dot. This opaque dot provides a dense, hard core for all the dots on the negative, but since it is so small, it does not alter their size. It simply increases their opacity in the center (fig. 19-5). Flashing preserves detail in the shadow areas by building up the opacity of the dots so that they will not be lost when the negative is printed on the plate. These multiple exposures may be made in any order and in any combination of exposure times.

CONTACT HALFTONE SCREENS

Contact screens are more adaptable to offset reproduction than glass screens. They are less expensive and normally require less exposure time. An exposure with a glass screen, for example, may take five times as long as the same exposure with a contact screen.

Because the contact screen is used in direct contact with the film emulsion, it does not have a sharp crossline pattern. Instead, it has a diffuse pattern which is often described as "vignetted." In the vignetted pattern, there is a gradual decrease in density from the center to the outside of the dark areas. Actually the pattern of the screen resembles a checkerboard with fuzzy squares. The screen itself resembles a sheet of heavy film because of its flexible-base support.

Since the dot formation is not controlled by the lens opening when you are using a contact screen, you can use any effective lens aperture opening. The f/16 aperture opening is generally used for same-size shots. However, you can use any opening down to f/32 with equally satisfactory results.

The chances are that most of your work will be done with a magenta halftone screen. You can use filters, controlled flash, or the highlight bump exposures to vary contrast when you are using this type of screen. You can also control contrast to some degree by varying the period of agitation while the film is in the developer.

A two-step exposure, known as the controlled flash method, is used for the average run of work. It consists of a detail exposure made with white light (without a filter) and a flash made directly from a yellow lamp inside the darkroom.

The highlighting method is similar to the controlled flash method, but it requires an additional bump or highlight exposure (made without a halftone screen in the camera). The flash exposure is similar in both cases. Still development may be used to increase sharpness of detail during negative processing.

Bright copy or copy having extreme contrast is sometimes shot through a yellow filter. A magenta filter is sometimes used if the copy to be shot is very flat.

If you are using a gray halftone screen, you cannot control contrast by the use of filters. However, you can increase the contrast slightly by placing the screen on the vacuum back with the emulsion side out rather than against the film emulsion. A slight separation between the screen and film emulsion shortens the screen range and heightens the contrast of the negative. You can also control the contrast by manipulating the flash exposure time to produce the desired dot sizes in the shadow areas. The flash exposure normally flattens the negative contrast because it increases the size of the dots in the shadow areas. You can also control contrast in the highlight areas by using a bump exposure or by manipulating the period of agitation during development. (Still development decreases negative contrast and agitation increases it.)

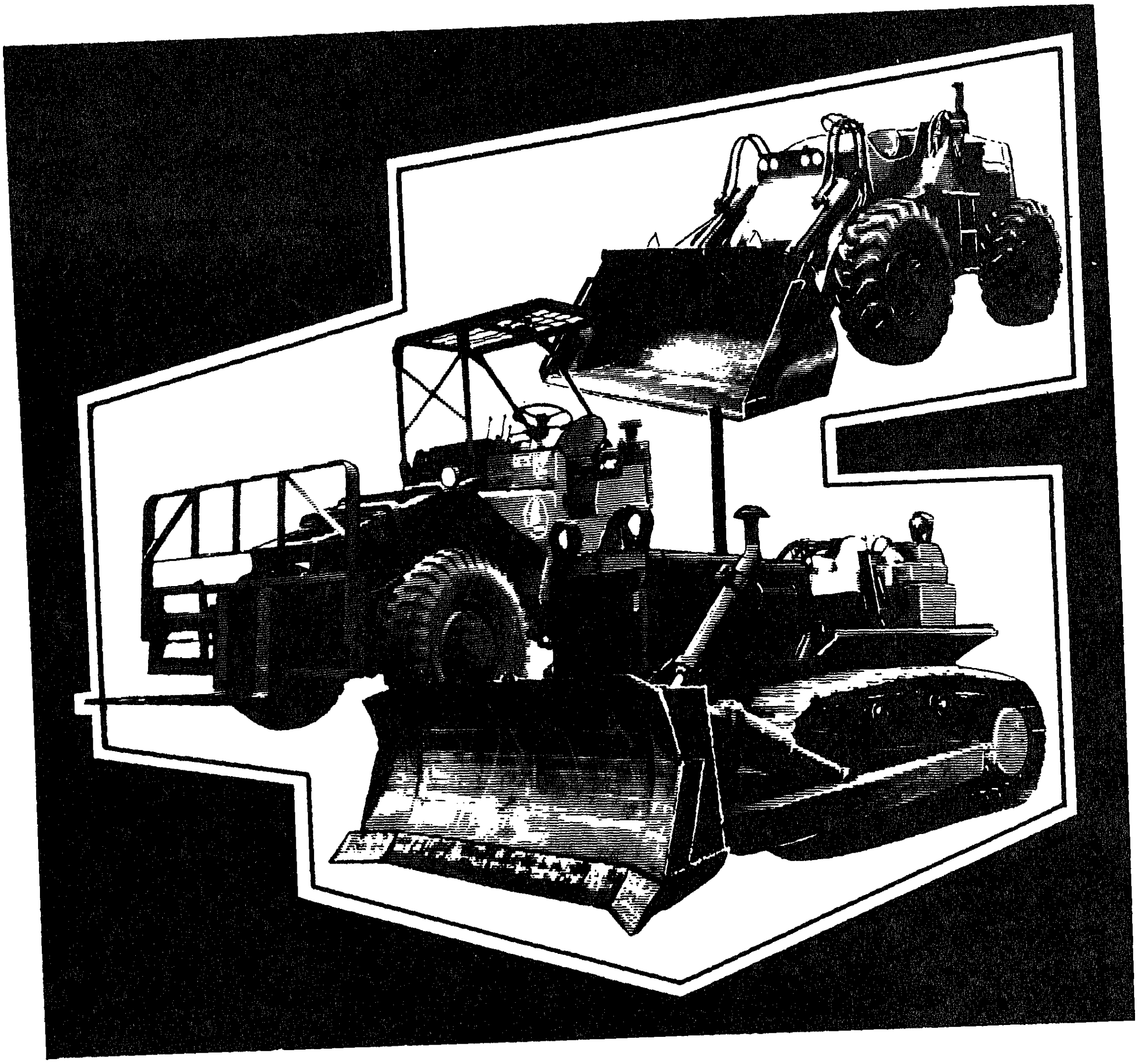

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Figure 19-6.—Scratchboard effect produced by copying a continuous-tone original through a single-line halftone screen. You can control contrast by varying the flash.

OTHER TYPES OF HALFTONE SCREENS

Besides the conventional magenta and gray contact screens, you may come across elliptical dot screens and Respi contact screens. When you use these screens, contrast is controlled in much the same manner as it is controlled with conventional screens.

The scratchboard effect shown in figure 19-6 was produced by copying a continuous-tone photograph through a 65-line, straight-line gray contact halftone screen. Straight-line and other special-effect screens are similar to regular gray contact halftone screens, but are lighter in contrast to allow for faster exposure. They provide more control in converting continuous-tone copy originals into line copy. Of course, not every continuous-tone original can be used to advantage with these screens. Best results are obtained when the copy has sufficient contrast to allow the dropping of whites in the extreme highlight areas during the exposures.

AUTOSCREEN FILM

Autoscreen film requires no screen because it has a built-in dot pattern which is imparted to it during the manufacturing process. This dot pattern is produced by tiny variations of sensitivity in the emulsion. All areas of conventional film emulsions have equal sensitivity to the light. Autoscreen film emulsion is made up of thousands of tiny, light-sensitive areas, each more sensitive in the center than it is around the edges. Consequently, when the film is exposed, the light from the shadow areas is so weak that it only affects the center of the sensitive areas, and this produces small dots. The middletones reflect more light and are able to expose a larger portion of the sensitive areas. The reflection from the highlight areas of the copy is great enough to expose all but the smallest areas of the emulsion. The halftone dot size, therefore, is graduated according to the amount of light striking these points of sensitivity on the film. The film is available in 133-line rulings and in sizes of 4 by 5 inches, 8 by 10 inches, 8 1/2 by 11 inches and 11 by 14 inches. Since no halftone screen is used, less exposure is required for making halftones with this film. It also produces sharper detail than can be produced by other processes.

Autoscreen Film 2563 (Estar base) has the ability to produce the same tone scale as the 133-line gray contract screen. This film produces harder dots and is easier to process than the other autoscreen film. It is not limited to certain developers and special techniques. Several liquid or powder litho-type developers can be used, and tray or machine processing can be employed.

Autoscreen film requires two exposures: a main exposure and a flash. Because no halftone screen is used, it is not possible to make a bump exposure to increase the contrast when you are working with autoscreen film. You can control contrast to some degree, however, by manipulating the flash exposure and the amount of agitation during development.

PROCESSING DIFFICULTIES

In spite of all the refinements and improvements to film and equipment, there is still no foolproof method that ensures a perfect halftone each time you make an exposure. Many negative difficulties are caused by little slipups, such as forgetting to take the cap off the lens before the exposure or putting the hypo in the developing tray by mistake. But there are other difficulties that are more complex, and it may take longer to track them down. The remainder of this chapter will discuss some of these problems and suggest some possible remedies for them.

IMAGE DEVELOPS TOO SLOW

If it has been properly exposed, the film will start to form an image after being immersed in the new developer for 30 to 50 seconds. Of course, this time will vary according to the strength and temperature of the developer and the amount of agitation used.

If it takes more than 50 seconds to distinguish the image on the film, the developer may be too cold or too weak. To determine the condition of the developer, expose a small piece of film and develop it in the solution. It is a good idea to keep small strips of exposed film available for testing the developer. You can make these test strips by exposing a sheet of film in the camera and then cutting this undeveloped film into strips. Store these strips in a lightproof container for use as you need them. If the test strip does not develop properly, the developing solution is at fault. You should heat the solution to 68 °F or replace it with fresh developer.

Most camera operators change the solution completely after a certain number of negatives have been processed. Just how often you will need to change the developer depends on the amount of solution your developing tray holds and the size and kind of negatives you are processing. It might be possible, for example, to put through twenty 24- by 30-inch negatives in a 6-gallon tank before changing the solution. If the negatives were smaller, you could process more of them. If you were using a tray holding less developer, it would be necessary to change the solution more often. Since the developer oxidizes rapidly, it loses its effectiveness if left in an open tray for 24 hours.

You will find that it is necessary to extend the development time slightly as the solution starts to lose its strength, and you should allow for this when you are developing by the time-temperature method. You may also wish to extend the development in order to keep from placing fresh developer in the tray near the end of the day.

There is no hard-and-fast rule as to when the developer should be changed. However, you should be able to work out a system for your own shop with a little judgment and experience.

If the image on the film is slow in coming up while a test strip develops properly, the chances are that your film was underexposed. The image will not show up on an underexposed negative in the specified time, and it will take much longer to develop it to the proper density. If you are developing by the time-temperature method, you may find that the dots in the negative are small and weak—both in the highlight and shadow areas. You can increase the density of the negative by forced or prolonged development, but forced development often causes fog in the highlight areas, and it may also cause the negative to turn brown (or brownish green). Such a negative not only creates a problem for the plate maker but may also result in a flat print when the job is run.

Before making another negative, you should check your lens opening and the coverage of the camera lamps. Allow for the filter factor, color of copy background, and the halftone screen, and then increase your exposure time as necessary.

IMAGE DEVELOPS TOO FAST

When the image appears too quickly, it is generally due to overexposure or to the developer which is too warm.

Heat causes the hydroquinone in the solution to become overactive, resulting in overdevelopment, fogging, and filling in of fine detail. High temperatures also shorten the useful life of the developing solution, and excessive heat may soften the film emulsion and cause reticulation (breakup of the emulsion) and frilling (separation of the emulsion from the base along the edges).

Of course, a temperature-controlled sink is ideal for controlling the temperature of a processing solution. But if such a sink is not available, you may be able to lower the temperature by placing the tray of solution into a larger tray of cold water. You can add ice cubes to the water as needed to maintain the proper temperature. If ice or cold water is not available, you should try processing the film early in the morning before the temperature starts to rise.

An overexposed negative always develops too fast. The image literally pops up when the film is placed in the developer, and if the negative is given normal development, the transparent openings in the opaque highlight areas may fill in and the opaque dots in the shadow areas will be large and heavy. On the other hand, if you cut the development short, the dot formation may suffer, and you will have considerable loss of detail.

A test strip of film immersed in the developing solution will indicate whether quick development was caused by overexposure or warm developer. If the test strip develops properly, the negative was overexposed. If it develops too fast, the developing solution is too warm or too strong.

DEVELOPMENT BY INSPECTION

Because of variable factors, such as the diminishing strength of the developer as film is processed and small light variations in exposures, some camera operators prefer to develop by inspection rather than by the time-temperature method.

Since line negatives should have dense black solids in nonprinting and transparent printing areas, you should check these negatives closely both for opacity and fog during the final stages of development. Examine the negatives briefly after the emulsion side has darkened and as often as necessary thereafter to prevent overdevelopment. Make all of these examinations brief and return the film to the developer as soon as possible. Always hold the film by the edges when inspecting it so that you will not mar the image areas with fingerprints (fig. 19-7).

Slightly extended development will fill in pinholes in the opaque areas of line negatives, but it may also cause fine lines and small type to fog. Watch fine areas carefully during development and pull the film at once if you see them filling in.

In checking negatives for opacity, you must keep in mind that the film still carries unexposed

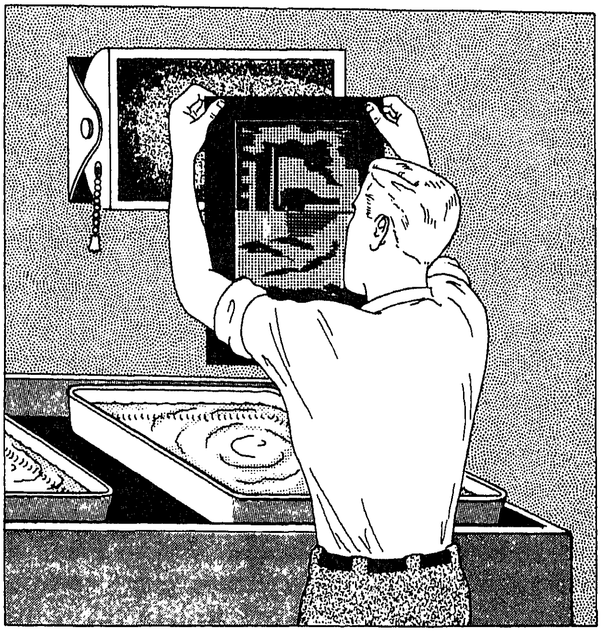

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Figure 19-7.—Examine the negative briefly during development. Hold the film near the edges so that the developer heated by your hand does not run down across the image.

silver salts that may make the negative look more opaque than it really is. Some camera operators are able to judge density by holding a ruler between the negative and the safelight and comparing its shadow with the opaque areas of the film. Others hold the film about 18 to 24 inches from a ruby bulb to test opacity. When it is no longer possible to distinguish the bulb's filament by looking through the opaque area of the negative, the film is sufficiently developed.

Halftones are more critical than line negatives. If it is necessary to make a detailed examination of a halftone negative during development, you should stop the action of the developer while you make the inspection. Do this by rinsing the film in fresh water or a mild stop bath (acetic acid solution). The acid rinse will stop the developing action more abruptly than fresh water, but if you use a stop bath, the film must be rinsed in fresh water before it is returned to the developer. If the acetic acid is not removed, it will weaken the developer and may cause underdevelopment in certain areas of the film.

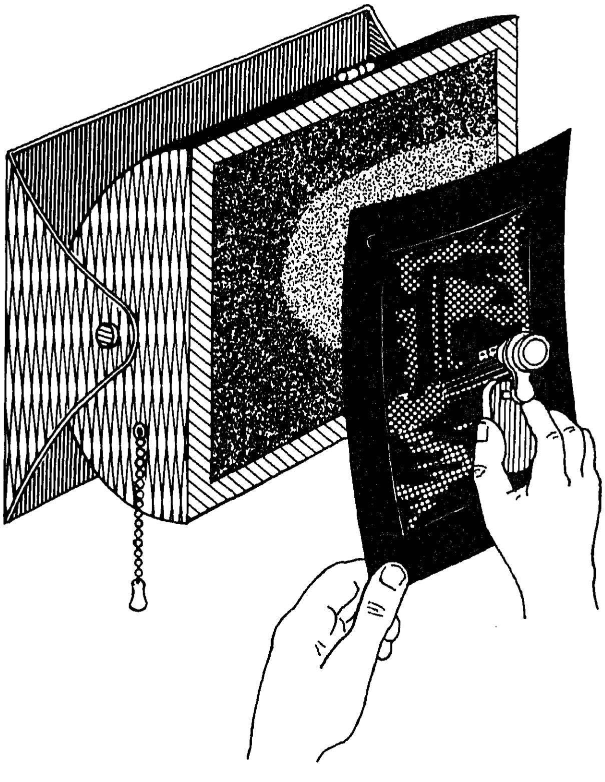

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Figure 19-8.—In this illustration, the linen tester is held against the acetate side of the film. The emulsion side is facing the safelight, but is held away from it.

To rinse the film in this manner is not necessary if you keep the examination of the negative brief. However, you should know where the highlight and shadow areas are located on the film so that you will not lose time looking for them. It is a good practice to make a mental note of the location of these areas on the copy before you make the exposure and then associate them with corresponding areas on the negative. This may not work, of course, if you make several exposures at once and then process the negatives as a group.

Some camera operators examine the film by holding it up with the emulsion side about 1 foot from the safelight. This allows them to look through a linen tester held against the acetate side (fig. 19-8). Others hold the film with the emulsion side facing them. This allows placing the acetate side against the safelight, but requires that the linen tester be held farther away to prevent scratching the film emulsion. If the linen tester is held too close to the emulsion, heat from the camera operator's hand may cause overdevelopment in some areas of the film (fig. 19-9). Many camera operators feel that the film should be kept a short distance away from the safelight at all times. Actually, the acetate side of process films

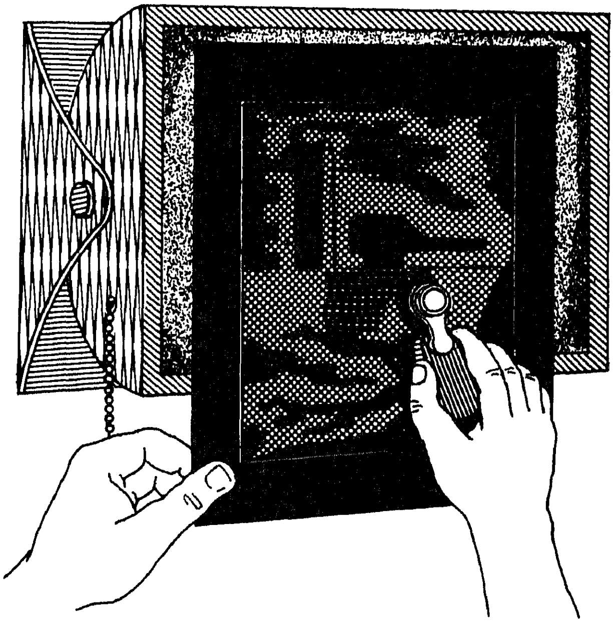

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Figure 19-9.—In this illustration, the acetate side of the negative is held against the safelight. Examination is made from the emulsion side, but the linen tester is held away from the emulsion surface to prevent scratching and uneven development.

may be placed against the safelight for short periods without harmful results.

If there is sufficient space at the side of your developing sink, you may wish to attach an illuminated glass-topped viewing table or drainboard. If your sink does not have such a device, you may be able to have one constructed. You can have the viewer equipped with two switches and two light bulbs—one ruby and one white. With such an arrangement, you can use the device to examine negatives during development and for checking fixed negatives or removing fog with Farmer's reducer. The viewing device must be watertight; otherwise, water may get inside and cause an electrical short.

In checking halftone negatives, you should watch the overall contrast between the brightest highlights and shadow areas. Look for detail in clothing and highlights in the hair or other suitable areas. You should also check to see that the highlight dots are joined at the corners with a round opening in the center. There should also be a square middletone dot and a 10-percent pinpoint dot in the shadow areas.

Some camera operators have difficulty in focusing in quickly with a linen tester, especially those who wear glasses. If linen testers are difficult for you, try using a rectangular magnifying glass to examine the negative during development.

A negative of a gray scale is also useful as a means of comparison when you are developing halftone negatives. You can produce a master gray scale negative by photographing a gray scale (fig. 19-10) and processing it under ideal conditions for the recommended time. Then in the future, when you are working with uncertain copy, you can place a gray scale on the copyboard and photograph it along with the copy. During development you can compare the gray scale on the new negative with that on the master negative. Keep in mind that the master will appear slightly thinner than the new negative because the new negative still contains unexposed silver salts.

You may want to bring up larger shadow dots when you are working with negatives for jobs that are to be run on certain kinds of coated paper stock. Some camera operators expose and develop the film to produce hard black shadow dots approximately twice the size of the transparent openings in the highlight areas. When the plate is printed, the light causes the highlight dots to grow larger and the openings in the shadows to grow smaller. This produces a balanced print.

STREAKED OR DISCOLORED NEGATIVE

Uneven development is generally due to the following:

1. Failure to submerge the film evenly in the developer
2. Not enough developer in the tray
3. Insufficient agitation
4. Air pockets or bubbles forming against the emulsion during development
5. Improper handling of the film while examining it during development
6. Faulty condition of the film

To immerse the film in the developer evenly, grasp it by two corners and draw it under the surface of the developing solution with a flat, scooping motion. Draw the film through the solution once with the emulsion side down and then turn it over in the tray so that the emulsion side is facing up.

If the film is so large that it almost fills the tray, draw the film into the developer with the emulsion side up. This will prevent the emulsion on the trailing edge of the sheet from rubbing as it passes over the rim of the sink or edge of the

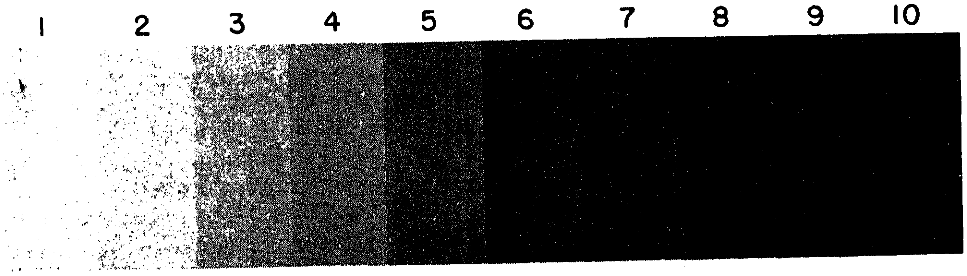

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Figure 19-10.—Gray scale.

tray. Large sheets of film are sometimes dipped in plain water before they are placed in developer to ensure quick coverage and even development.

Most camera operators rock the tray to agitate the solution during the early stages of development. Agitation shifts the spent developer and brings the fresh solution into contact with the film emulsion. It also keeps air bubbles from attaching themselves to the film and prevents the colder developer from stratifying or settling to the bottom. Too much agitation may cause the film to develop too fast, of course.

When developing negatives made with contact screens, camera operators often agitate the developer during a portion of the developing time and use still development for the remainder of the period. Still development tends to bring out fine detail but it reduces the highlight contrast. You can regulate the negative contrast to some degree by varying the period of agitation.

Air pockets frequently form under a sheet of film and cause uneven development if the emulsion side is down. You may be able to remove this air by rocking the tray once or twice. If this doesn't work, pull the film from the developer and resubmerge it.

Any examination of the film during development should be brief unless the developer is rinsed off. If an unrinsed sheet of film is kept out of the developer too long, it will become streaked by uneven development. The developer will run down to the lower edge, and the emulsion will be affected according to the amount of developer that remains on it. You should not touch the image areas on the emulsion side when handling the film.

If the acetate side of the film is held against or close to the safelight, the heat from the bulb may also affect the film. It is a good idea to wipe off the face of the safelight with a cool, damp sponge before placing the film against it.

Negatives sometimes turn brown when the developer is old or hot. Greenish brown negatives are generally the result of underexposure and forced development. Discolorations and streaks may also be caused by old fixing baths or failure to submerge the negative completely in the fixer. Occasionally, negative streaks are caused by improper illumination, resulting in glare and uneven exposure.

Breaks or holes in the emulsion are often due to handling the unexposed film with chemicals on your fingers. Always wash your hands and dry them thoroughly before handling the film. Don't hold the corner of the film while it is in the developer, as this may cause frilling or pinholes in the emulsion.

If normal development causes the film to turn black all over or if the film is dark with an indistinct image, you can generally chalk it up to old film or film that was accidentally exposed before it was put in the camera. Film may also fail to develop properly if it has been stored in a space where the temperature changes from one extreme to another.

You should always be suspicious if large batches of film appear to have been preexposed. This may be due to radiation. X rays are particularly destructive to emulsions, so make it your business to know where and when X rays will be used during your yard period.

Some types of film with a synthetic binding in their emulsion do not carry an expiration date on the label. This is because their life is considerably longer than normal.

FOG OR FILL-IN NEGATIVES

Fog is a thin deposit of silver in the transparent areas of the negatives. When negatives are fogged, small type and fine lines will tend to drop out or to print broken and uneven on the plate. Solid printing areas will be speckled and halftones will print glaring highlights due to the drop out of the small dots. If such negatives cannot be cleaned with Farmer's reducer or scratched clean with an etching needle, they should be reshot.

Fog may be caused by old film or by accidental exposure of the film to light. It may also occur when film has been stored in a space having a hot or unstable temperature.

Gradual fill-in or fog from the opaque areas of the film may be due to overdevelopment of a negative made from copy which lacks detail and contrast. Gradual fill-in may also be caused by underexposure and forced development or warm or harsh developer. Overexposure may also cause fog if you do not cut the developing time accordingly. If only a portion of the negative fogs, the trouble may be due to uneven development, accidental exposure to light, or glare from uneven illumination of the copy.

Underexposure and old developer may prolong development to the point of fogging. Developer should not be used when it has deteriorated to such an extent that unduly long processing time is required. If the negative seems to be underexposed (or overdeveloped), adjust your exposure time accordingly when you make your next shot.

The negative may acquire a brown stain during the processing operation if it is not completely fixed. Yellow or greenish stains may occur if negatives are not rinsed before they are put into the fixer. This is due to the developer in the film emulsion acting on dissolved silver in the fixer. Such stains are more likely to occur when the acid in the fixing bath is weak or spent.

Although kits are available for checking the strength of the hypo solution, most camera operators keep a few small strips of unexposed film on hand for checking purposes, and test the fixer occasionally by dropping one of these strips into the solution. The film should clear in 40 seconds if the fixer is fresh. The solution should be discarded when it becomes cloudy or milky and requires 70 to 80 seconds for clearing a negative. You should drain the old fixer and clean the container before adding fresh solution.

Some agitation or movement of the film in the fixing solution is necessary to assure complete fixation. When more than one piece of film is in the bath, two sheets may stick together and prevent the solution from circulating between them. If the negative is not completely submerged, portions of it may not be fixed properly or the developer may continue to work in the uncovered areas and the negative will streak.

If the hypo is not completely washed out of the emulsion, it may crystalize and cause the negative to look frosty or milky weeks later. If this happens, you may still be able to print the negative on the plate, but you must increase the exposure time to allow enough light to pass through the affected area for an adequate burn. If it is necessary to clear the negative before using it, you should run it through the fixer a second time; then wash it thoroughly. Negatives containing deposits of crystalized hypo should be cleared if they are to be saved for future use. If they are not cleared, these negatives will eventually deteriorate.

Precautions for Minimizing Fog

You can minimize fogging by taking the following precautions:

1. Keep film away from radiators, steam pipes, and so on.
2. Guard against accidental exposures.
3. Use proper safelights (filters and bulbs).
4. Stop light leaks, such as holes in the darkroom bulkhead, holes in the camera's bellows, or cracks in safelight filters.
5. Keep foreign chemicals away from processing solutions.
6. Keep the darkroom tabletops, trays, sinks, and other equipment clean.
7. Keep the camera clean, especially the lens and copyboard glass.
8. Keep bright lights away from the camera while you make camera exposures if such lights are not required for copy illumination.

Fog Due To Radiation

If negatives fog repeatedly without any apparent explanation or cause, you should report this fact. The fog may be due to radiation of some type or to extreme heat.

Farmer's Reducer

Fogged or filled in negatives are not always useless. If such negatives are not too badly fogged or filled in, you may be able to clean them up enough to produce an image on the plate. For example, you may be able to clean small affected line areas by scratching the emulsion side with an etching needle.

If the entire negative is fogged or filled in or if a small local area has too much fine detail to be scratched clean, Farmer's reducer may do the job. As you know, this reducer will dissolve the unwanted silver in the transparent areas. There are many formulas for mixing reducers, but here is one that is commonly used.

Stock solution A

Potassium ferricyanide...........	1 1/4 oz
Water to make	16 fluid oz

Stock solution B

Sodium thiosulfate (hypo)........	16 oz
Water to make	64 fluid oz

These two stock solutions lose their strength in 10 to 15 minutes after they have been mixed. They are also affected by light. Because of this, you should store them separately in brown glass bottles and not mix them until you are ready to use them.

When you are ready to use the reducer, mix 1 ounce of stock solution A with 4 ounces of stock solution B and add 16 ounces of water. A full-strength solution should be lemon yellow in color. The color diminishes as the solution becomes inactive.

Place the negative in a tray of the solution and agitate the reducer slightly by rocking the tray. Watch the negative closely to see that the reducer does not cut back the opaque areas too much. As soon as the fogged areas are cleared, remove the negative from the reducer and place it in a tray of hypo. Make sure the negative is completely submerged because the reducer's clearing action will continue until it is stopped by the hypo.

If only a portion of the negative is fogged, you may be able to clear it by localized application of the reducer. Fill a small container one-third full of stock solution A. You may add a varied amount of stock solution B to this to cut down the strength of the potassium ferricyanide. (The ferricyanide dissolves the silver on the film and the hypo controls the action of the ferricyanide.) Fill a second container about two-thirds full of hypo taken directly from your standard fixing solution.

Place the negative on a light table so that you can see what you are doing (preferably a waterproof light table attached to the developing sink). Apply the reducer from the first container with a swab of cotton. Rub the area lightly. If it doesn't clear in a few moments, apply more reducer. If the fog still does not clear, the reducer may be too weak. In this case, you should add more stock solution A to the container and repeat the process.

As soon as the fogged areas clear sufficiently, you should stop the action of the reducer by applying hypo from the second container. Apply enough hypo to stop the clearing action immediately. Rinse the negative in water before going on to clear other areas on it.

It is better to clear (cut back) negatives with Farmer's reducer just after they are fixed and before they have dried. You can cut back dried negatives if you soak them first in lukewarm water to soften the emulsion. After negatives have dried, they are slower to respond to the reducer. However, once the reducing action begins, it is usually very fast. You must be ready to stop the action of the reducer immediately with hypo.

CAUTION: Remember that cyanides are poisonous. In contact with acids, they produce deadly fumes. You must follow safety precautions carefully when handling them.

RETICULATION AND EXCESSIVE GRAIN

In time, the acid of the fixing bath will become neutralized by developer brought into the bath with the film. When the acid is neutralized, the film emulsion will not harden as it should. The emulsion will also tend to remain soft when temperatures of processing solutions are above normal. If the wash water is hot enough, it is actually possible for a soft emulsion to dissolve and wash down the drain leaving nothing but clear acetate. If excessively cold water is used for washing, the unhardened emulsion may swell or frill and partially separate from the acetate.

A difference in temperature between your processing solutions or between the solutions and the air may cause the film emulsion to reticulate. This is the formation of an irregular network of fine lines and cracks which give the film an overall appearance of grainy leather.

Hot, overactive developer is likely to cause excessive grain in a negative. Excessive grain may also be caused by rapid agitation during development or by the film being exposed to heat. Film should be stored in cool, dry spaces.

AVOIDING POTENTIAL CAMERA PROBLEMS

Process cameras are built for almost every purpose. Film sizes for these cameras range from 16 by 20 inches to 48 by 72 inches. The design of the cameras range from very simple for ordinary line and halftone work to extremely complex overhead structures.

The size and type of process camera initially installed in a printshop are determined by the Navy Publications and Printing Service. Many things are considered in selecting a camera for a particular shop. One of the most important factors is the scope of printing that is to be done in the shop. The size of the room or compartment to be used for the printshop and the necessity for even weight distribution throughout the ship or building are also considered.

In spite of all the planning that goes into the selection of the camera, the size of required copy may sometime exceed the limit of your camera. In such cases, you should try shooting the copy in sections and strip the negatives together. If you cannot do this because the presses are too small, check with the person who submitted the job to see if it can be printed in sections. Always let the printing officer know just what is involved in printing the more difficult jobs. The printing officer may be able to set up a screening system for such jobs and possibly recommend that some jobs be sent to a Navy Publications and Printing Service Office.

If you have a considerable amount of oversized work and a new camera is the only solution to your problems, you should plan for its installation during a yard period. It may be necessary to cut through bulkheads, rig chain hoists, weld over an ammunition space, and so on. By all means, have a yard work order ready for installation before the yard period. Always work closely with your supply officer and department head and be sure that you follow the correct procedure for getting new equipment and having it installed. Procedures for procuring new equipment were discussed in more detail earlier in this manual.

PRACTICE SAFETY FIRST AND LAST

A careless camera operator is a hazard to the shop. The camera operator can cause the camera to become a dangerous piece of gear by not observing safety precautions. You should see that safety precautions are posted near the camera and keep visitors out of the shop when you are making bright exposures. People tend to be curious about giant-sized cameras and may severely damage their eyes or even be killed if they are not aware of the dangers that exist when the camera is operated.

DIFFICULTIES DUE TO PROCESSING OR CAMERA SETUP

The following negative difficulties may be due to an incorrect camera setup or to improper processing.

NEGATIVE LACKS DENSITY

If the negative lacks density, the trouble may be due to underdevelopment or underexposure. It may also be that the developing solution was not properly mixed or was too cold. You should prepare processing solutions according to the manufacturer's instructions and keep them at the proper temperature and strength. This is particularly important when you are developing by the time-temperature method, since this method requires ideal processing conditions. To prevent underdevelopment, always leave the film in the developing solution for the full time required. If you are developing by inspection, leave the film in the solution until the image shows through on back of the film and sufficient opacity has been reached.

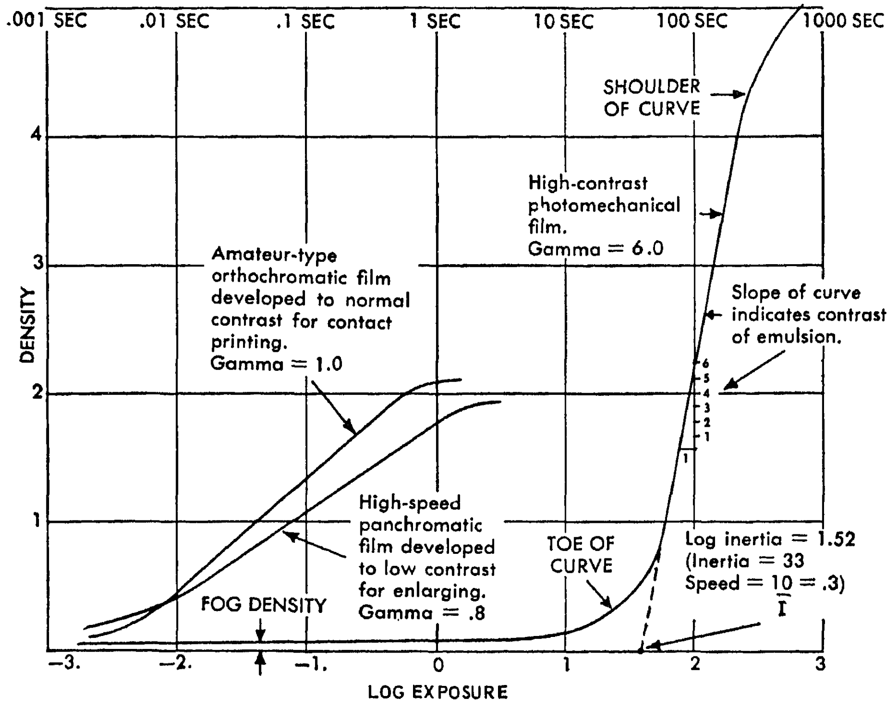
If the processing conditions are correct, thin negatives are generally due to underexposure and you should increase your exposure time or adjust your camera setup as necessary.

CHARACTERISTIC CURVE

Manufacturers generally prepare a characteristic curve for each type of film to show what can be expected from the film when it is used as recommended. It is easier to compare the curve of one film against that of another than it is to make trial exposures. A curve (fig. 19-11) is obtained by making a series of exposures on a piece of film. Then when the negative is developed, the densities of the various tones are measured on a densitometer and plotted on a graph against the logarithm of the exposures used in producing them.

The resulting curve is sometimes known as the H & D curve (after Hurter and Driffield, the men who developed it) or the D-log E curve. (The D stands for density and the log E for the logarithm of the exposure in meter-candle-seconds.) Logarithms are frequently used in making mathematical computations and are used here because the wide range of exposures could not be charted conveniently if a linear-type scale was used. By using logarithmic scales, the length of the curve is reduced, and it is easier to see the rate at which density increases with a given multiple of exposure. In the common system of logarithms, a number base of 10 is used. This means that the numbers used are based on the number 10 and multiples of 10 and that if zero on the scale represents a 1-second exposure, one will represent a 10-second exposure, two will represent a 100-second exposure, and so on. Density is the logarithm of the opacity of the film. A density of 1 represents an opacity of 10. A density of 2 represents an opacity of 100, and so on (fig. 19-11).

The characteristic curve is divided into three parts: the region of underexposure (toe), the



57.110

Figure 19-11.—Characteristic curve made by plotting density against the log exposure. Photographic sensitometry covers an extremely broad and technical field of study beyond that necessary for the average camera operator. However, an understanding of the fundamentals of film sensitivity will serve as an aid to proper exposure and development of film. The first step in sensitometry requires that the film be given a series of standard exposures in test strip form. These exposures under measurable and reproducible conditions are accomplished by the use of a sensitometer, an instrument having a light source and an exposing device (similar to a shutter) which controls the amount of light reaching the film. The unit of exposure is the meter-candle-second, which is the equivalent to the exposure produced by a light source of one candlepower in 1 second at a distance of 1 meter from the surface of the sensitive material. In making sensitometric measurements, a strip of the material to be tested is given a series of graded exposures so that when it is developed, it will show varying amounts (steps) of silver deposits. A typical range of exposures covers a scale of grays with the amount of silver varying from a minimum (fog density) to maximum silver deposit. There are two types of sensitometers. Those designed to vary the time of exposure are called time scale sensitometers. They allow an even intensity of light to strike the emulsion, but have a device which controls the length of time the light is allowed to act. This device is an opaque plate containing a series of slits of different lengths which move between the film and light source and might be compared to a shutter. It causes each portion of the emulsion to receive a separate and different exposure. The other type of sensitometer is called an intensity scale sensitometer. It uses a step wedge (gray scale on film) to hold back part of the light so that some portions of the test strip of film receive more exposure than the others even though the same exposure is used for all parts of the film. In either type of sensitometer, the exposure received by each step increases by the square root of two. In other words, the exposure for each of the alternate steps is doubled. An emulsion exposed in a sensitometer is referred to as a sensitometric strip. In order to understand and interpret the results of the sensitometric test, it is necessary to plot the density of each step in relation to the exposure required to produce it in the manner shown in the chart above. The density is determined by measuring each step of the test film with a device known as a densitometer. There are several types of densitometers. However, all of them measure (through an optical system) the ratio of light transmitted to the light incident on the silver deposit.

region of correct exposure (straight-line portion), and the region of overexposure (shoulder).

The toe is the area in which the exposure first begins to affect the emulsion. You will notice on the chart that as the exposure increases, there is a slight increase in density. This area, also known as the threshold, is defined as the region of unequal rise because the density does not increase in proportion to increases in exposure. Some film manufacturers use a portion of the toe area for determining film speeds.

The straight-line portion of the curve is the most important. The straight line indicates that for each increase in exposure, there is a corresponding and equal increase in density. This is the region of correct exposure.

The upper portion of the curve, known as the shoulder, again gives an unequal increase in sity and is in the region of overexposure. Once reach the shoulder, further increases in osure actually result in less rather than more sity and the curve starts downward. This is ed reversal or solarization. The exposure uired for reversal is so great, however, that it f little concern to the Lithographer.

TEGRATED TONE DENSITIES

As you know, in continuous-tone work, tone dations are produced by the differences in the sities of the silver deposits on the film. Normal trast is represented by a full range of densities n dense blacks through intermediate grays to nsparent, open areas.

High contrast negatives, such as those made n process film, do not have a full range of sities. They consist only of dense blacks transparent areas. Therefore, when camera rators speak of contrast in a halftone negative, y are referring to integrated tone densities. The es in the halftone are produced by a series of s all having approximately equal density, but ying in size. The size of the dots is controlled the exposure and to some extent by development. Screen distance and the size of the aperture affect the dot size when glass halftone screens used. The integrated tone density of the tone negative depends not only on the size and city of the dots but also on the clear space und them. The density of the individual dots the negative might read as high as 3.0 on a sitometer, but the transparent open space und the dots subdue their tone so that the nsmission or integrated tone density reading be considerably less.

If you examine a halftone negative with a sitometer, you will find that a 10-percent dow dot blocks out 10 percent of the light and ws the other 90 percent to pass through. iding the total input of light (100 percent) by amount of light transmitted through the ative (90 percent), you get 1.11. If you consult ble of logarithms to the base of 10, you will l that the log of 1.11 is approximately 5. Thus, the integrated tone density for the percent shadow area is 0.05, even though the sity of the individual dots is far in excess of figure.

Similarly a 50-percent middletone dot holds k half the light so that only 50 percent gets ough. One hundred divided by 50 gives 2, and log of 2 is 0.3. By using the same process, you find that a 90-percent highlight dot has a integrated tone density of approximately 1.0. Of course, in actual practice, camera operators refer to the readings on the densitometer instead of making computations, such as these, for the various tone areas.

EFFECTS OF INCREASED EXPOSURE

Since dot size and tone density are not proportional if you increase the exposure, you will produce a greater tone difference in the shadow areas of the negative than in the highlights. Underexposure causes the shadows of the copy to fall on the toe of the H & D curve. This results in poor reproduction. As the overall exposure is increased, the densities of all tones are increased, and the contrast is strengthened and improved. A steep incline in the curve for process film indicates an abrupt break from low to high density. As a result of a slight increase in exposure, a slight increase beyond the threshold exposure will produce small dots with a heavy density. As more light passes through the openings in the halftone screen due to a larger aperture or to increased exposure, the dots grow in size. Of course, if the exposure is increased too much, the highlights of the image will fall on the shoulder of the curve, and this will produce a very dense negative with plugged highlights.

In halftone work, increased exposure fills in the shadow detail, while prolonged development and continuous agitation builds up the denseness of the halftone dots. This affects the halftone dots in the highlight areas more than those in the shadows. If the film is underexposed, it may be possible to bring up the density of the dots by forced development. However, if the film is greatly underexposed, the dots will still be small in both the highlights and shadows and the resulting negative will have little contrast. In this case, increasing the exposure will increase the overall contrast and density range.

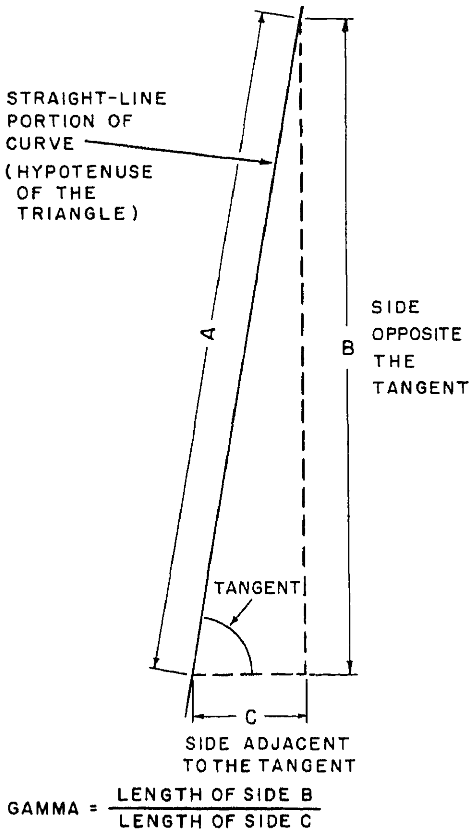
GAMMA

Since underexposure flattens the shadows and overexposure flattens the highlights, you should try to use an exposure that will keep both the shadow and highlights on the straight-line portion of the curve. If you will study figure 19-11 for a moment, you will see that it is possible to vary the exposure somewhat without getting off the straight-line portion. You can also expand or compress your contrast without going off the linear portion of the curve. You can do this by varying your highlight exposure and your flash. You can further control your negative density and contrast through development.

Most high contrast films offer considerable leeway in exposure and development. By manipulating the development, you can make usable line negatives from film underexposed as much as 25 percent or overexposed as much as 50 percent. Process films also represent considerably more spread in halftone exposure than other films offer. Continuous-tone films normally have a latitude of three stops in exposure which takes care of the highlights and shadows satisfactorily for most copy work. It also makes it possible to shoot for the highlights with a reasonable expectancy of holding the shadow detail. These films also have considerable latitude in development.

The straight-line portion of the curve for continuous-tone film is often sloped at a 45-degree angle. If you determine the amount of development contrast or gamma for this film by the method shown in figure 19-12, you will find that it has a gamma of one. This means that the density of the negative is directly proportional to the increase in exposure and the contrast of the negative is the same as that of the original. If the slope is steeper, the contrast of the film is greater. Most process film can be developed to a gamma of 3 to 10, indicating that the density is 3 to 10 times that of the original. The gamma keeps building as long as the film is in the developer until it finally reaches a point where it levels off. After that, further development will cause fog and actually reduce contrast rather than increase it.

The total contrast of the negative depends on several factors—the contrast of the original copy, the exposure time, the time of development, the temperature of the developing solution, the amount of agitation used, the strength of the developer, and so on. So remember, when you speak of gamma, you are talking of development contrast only. Development and exposure are ordinarily the two most important factors in controlling negative density.


STRAIGHT-LINE PORTION OF CURVE
(HYPOTENUSE OF THE TRIANGLE)
A
B
SIDE OPPOSITE THE TANGENT
TANGENT
C
SIDE ADJACENT TO THE TANGENT
GAMMA = LENGTH OF SIDE B / LENGTH OF SIDE C

113.91

Figure 19-12.—To determine gamma, select any point along the straight-line portion of the characteristic curve and draw a vertical line down (for any convenient distance). Next draw a horizontal line (at a right angle to the vertical line) to connect the vertical line with the straight-line portion of the curve. This will give you a right-angle triangle, as shown here. Gamma is a Greek letter used to represent the measurement of the tangent of the angle formed by the straight-line portion of the curve and the base line of the triangle. When you have a right-angle triangle, you can find the tangent of the angle by dividing the length of the side opposite the angle by the length of the side adjacent to the angle. In the diagram shown here, the gamma equals the length of side B divided by the length of side C. If side B is 9 picas long and side C is 1 1/2 picas long, you have a gamma of 6. If side B is only 1 1/2 picas long, you have a gamma of 1.

SPECIAL TYPES OF DEVELOPERS

Types of developer are on the market which will develop film to a specific gamma regardless of immersion time and temperature. The camera operator exposes for gamma and then develops the film in the usual manner. Chemical fog will not set in regardless of length of time the film is left in the developer or the temperature of the solution. Such developers are particularly useful in processing negatives which are to be used for laying tints, since these negatives are frequently large and are difficult to immerse and develop evenly in conventional developers.

NEGATIVE THIN IN CORNERS

The light rays passing through the outer edges of the lens are always weaker than those passing through the center. This is because these rays travel at an angle, and they are spread more and travel farther than those that are moved nearly in line with the optical axis of the lens. This may cause large negatives to be dense in the center and thin in the outer edges and corners. You may be able to remedy the situation by using a lens with a longer focal length.

Negatives may also be thin in the outer edges and corners due to uneven illumination. You can remedy this situation by increasing the distance of the lights from the copy and adjusting the exposure as necessary. You can also use glass disks or other types of diffusers over the lamps or improvise large cardboard reflectors below and above the copyboard to reflect light onto the edges of the copy.

In some cases, making an exposure with the lens wide open will cause the corners of the negative to be thin. You can remedy this by stopping the lens down and using a longer exposure.

In an emergency, you may be able to bring up thin corners by rubbing them during development. This speeds up development in the light areas. However, this practice is not recommended for the average run of work because it may cause scratches and other negative defects.

NEGATIVE HAS TOO MUCH CONTRAST

You have just seen how exposure and development affect negative contrast. Contrast is also affected by the contrast of the original copy. If you are using a glass halftone screen, contrast is also affected by the size of the highlight opening, the screen distance, the amount of flash used, and the position of the camera lamps. If you are using a contact screen, contrast is not affected by the size of the lens opening. However, it may be varied by the use of filters, by the use of a bump exposure, by the manipulation of the flash exposure, and by varying the amount of agitation during development. Similarly, when you are working with autoscreen film, you can control contrast by varying the flash or the amount of agitation during development.

The three-exposure method, consisting of a flash, detail, and highlight exposure, is the most effective when glass halftone screens are used. A detail exposure and a flash (or a detail, flash, and bump exposure) should be used with contact screens. Two exposures are normally used with autoscreen film—a flash and a detail exposure.

If the original copy is extremely contrasty with sharp, abrupt breaks between the highlights and shadows, the negative will tend to be overcontrasty and lacking in detail. If you are working with a glass halftone screen, you can produce a better negative by using a smaller highlight stop than usual and increasing the shadow (flash) exposure slightly. This produces larger dots and smaller highlight dots in the shadow areas and tends to preserve the middletones. Decreasing the screen distance will also flatten the contrast, but camera operators rarely resort to this.

If you produce a negative with too much contrast from normal copy, the chances are that the film was overdeveloped or overexposed. If the contrast is due to an overactive developer, the openings in the highlight areas will be slightly fogged, and there will be a slight loss of definition in the shadow areas.

To correct this situation, you should first check the temperature of your developing solution and cool it if necessary. If the temperature of the solution is correct, check the activity of the solution with an exposed test strip of film. If the developer is overactive, dilute it slightly or replace it.

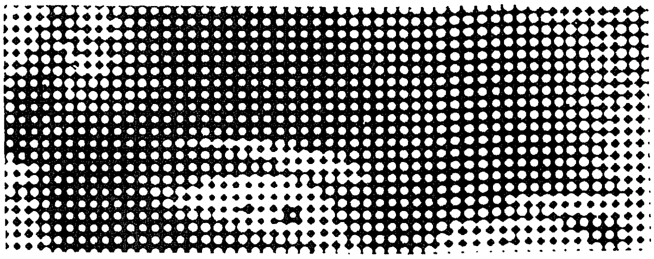
If the dots in the shadow areas are large and dense and if the highlight dots literally collide with little or no transparent openings between them, the negative has been overexposed. You can remedy this by reducing the highlight exposure or using a smaller aperture when you make your next negative.

If you find the shadow areas are wide open with no dots at all or that dots are small and weak, either the flash was too short or it may have been omitted. The trouble may also be due to improper screen distance or an incorrect lens aperture opening.

NEGATIVE HAS TOO LITTLE CONTRAST

When the negative has small highlight dots and large shadow dots, the print will be flat and gray because there is little difference in the size of the dots (fig. 19-13).

If you are using a glass halftone screen, this lack of contrast may be due to flat copy, a prolonged flash exposure, or an inadequate highlight exposure. Old developer or improper positioning of camera lamps may also cause negatives to be flat. If the screen distance is too short, it will also tend to flatten the negatives (fig. 19-14).



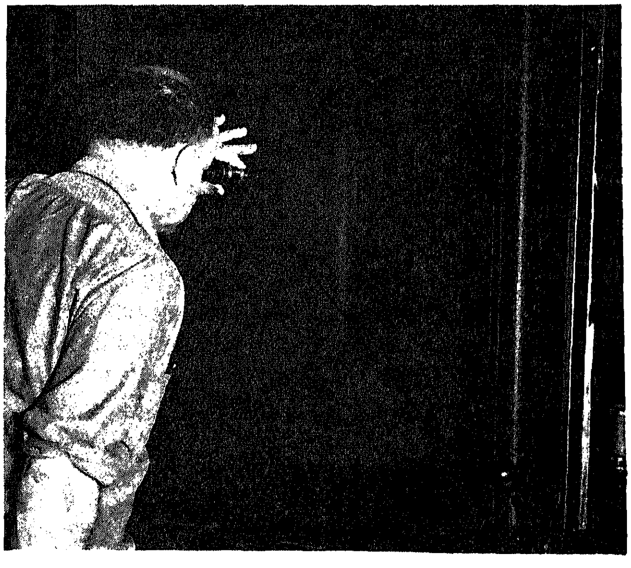
113.94

Figure 19-13.—The negative will lack contrast if highlight dots are too small and shadow dots are too large.

When the original copy is flat, you may be able to improve it by using a larger highlight stop than usual. Or you can use a longer highlight exposure and reduce the other exposure times proportionately. This will create larger highlight dots and provide more distinct breaks between the dark and light areas.

It may also help to decrease the time for the flash exposure, because the flash tends to gray the dark areas and flatten the negative farther. Occasionally, it may be necessary to reduce the length of the detail exposure.

If the highlight dots are small and fuzzy, the chances are that the exposure was too short and development was forced until fog set in (fig. 19-15). If all the dots are weak and transparent, the negative was underexposed or underdeveloped.



113.73

Figure 19-14.—Use a linen tester to check the image on the ground glass.

When there is a question regarding the density or sharpness of the halftone dots, some camera operators make glossy prints from their halftone negatives on regular photographic paper. These glossies are then pasted up with the line copy, and the job is shot as line. Since fuzzy edges are burned out on line negatives, the halftone dots come out dense and sharp. This procedure may be used when the screen is fairly coarse, and the line copy is to be shot the same size. But complications may set in if great reductions are required. Reduction may cause fine halftone dots to fill in and go solid or to drop out altogether.

CONTROLLING CONTRAST WITH CONTACT SCREENS

When working with a contact halftone screen, if you produce a negative with too much contrast from normal copy, you should do the following:

1. Increase the flash exposure.
2. If you are working with a magenta screen, give a portion of the detail exposure through a yellow filter. (You cannot combine the color of a filter with the color of the screen to control contrast when you are working with a gray contact screen.)
3. Cool or dilute the developer with used developing solution.
4. Use still development, if necessary, to control contrast in the highlight areas and flatten the negative.

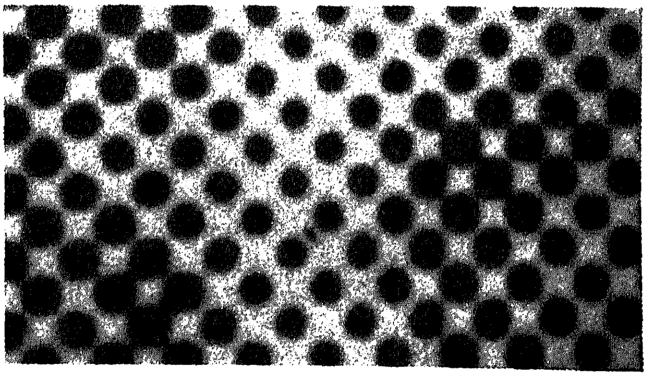


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Figure 19-15.—Fuzzy dots may be caused by underexposure.

If you are working with autoscreen film, you can reduce the contrast by increasing the flash or using still development.

INCREASING CONTRAST WITH CONTACT SCREENS

When you are working with a magenta contact screen, you can increase the contrast of the negative by doing the following:

1. Reduce the length of the flash exposure or eliminate the flash.
2. Use a bump exposure.
3. Make all or part of the exposure through a rose filter (Wratten No. 30).
4. Increase the period of agitation in the developer to increase the contrast in the highlight areas.
5. Change to fresh developing solution if the developer is weak.
6. Place the screen on the vacuum back with the emulsion side facing the lens rather than against the film.

You cannot use filters (combined with the color of the screen) to control contrast when you are using a gray screen. However, you can use any of the other methods listed above.

You can increase the contrast in autoscreen negatives by using less flash and varying the period of agitation during development.

MECHANICAL DIFFICULTIES

Although other factors may enter the picture, the following difficulties are generally caused by improper camera setup or mechanical failure of the equipment.

Blurred Image

If the image on the negative is blurred, you should try to find the cause and then reshoot the job. If the camera was positioned by scale, check the scale readings and then check the focus on the ground glass. In critical focusing, you should focus with the lens stop that will be used during the exposure because the image may lose its sharpness when you change the diaphragm opening. When you are using filters or the halftone screen, focus the image with the filter or screen in position because the filters and screen may also alter the focus. Be sure, too, that filters and Waterhouse stops are positioned properly when they are inserted in the filter slot. If the focal length of the lens seems to have changed, have a qualified operator check the inner and outer elements to make sure that they have not loosened.

Before making a camera shot, check the copyboard and vacuum back to see that they are all locked in the exposure position. If they are not locked in place, they may move and throw the fine detail of the image out of focus. In rare cases, you may find that the camera is out of adjustment. Procedures for making mechanical adjustments and repairs are discussed in this manual and in operator's manuals for your particular equipment.

Occasionally, blurred images are caused by movement of the camera. Although most cameras are constructed on a floating structure and are unaffected by movement, it is a good idea to keep movement to a minimum while the exposure is being made. Never rest your hand on the camera during an exposure.

Fuzzy or odd-shaped dots may be due to bulges in the film caused by a tacky stayflat coating or dirt on the stayflat surface or vacuum back. They may also occur if the film carrier is out of parallel with the screen or copyboard.

Fuzzy dots may also be caused by cold or spent developer or too great a screen distance. Too much screen distance generally results in fuzzy, overlapping highlight dots and weak, fuzzy shadow dots. Before making another exposure, you should check the screen distance and make sure that the screen is placed in the screen holder with the thick, cover-glass side (the side on which the serial number is engraved) facing the lens. You will not have the correct screen separation if the thick side is facing the film.

If the dots on the back of the film are larger or differ in formation from those on the surface or the front, the trouble may be due to halation (reflection) from the film base, the stayflat surface, or the vacuum back.

The manufacturers of film generally place a coating of dye between the emulsion and base to prevent internal reflections. This dye, known as antihalation backing, absorbs the light and presents it from striking the base and reflecting back into other areas of the emulsion. As an added precaution, however, you should check the vacuum back for worn spots and touch them up with a dull black paint.

Double spots may be due to improper illumination, halation, movement of the camera, or to the position of the Waterhouse stop in the filter slot. Always make sure that you get the stops in straight.

Moire

You may get a moire or fuzzy dot formation if you rescreen a previously printed halftone. If you examine your new halftone negative under a magnifier, you will see that in some cases the old dots print side by side with the new ones to form short lines. In other cases, they form a pattern similar to that produced when a full-color halftone is copied in black and white.

These lines and patterns may be pronounced, causing disturbing dot formations (moire) or fuzzy looking prints. The overall effect may be passable, even though the detail is slightly indistinct. Your problem when working with rescreening a copy is to photograph it in such a way as to minimize overlapping dot formations.

If the image on the previously printed halftone was produced by a fairly coarse screen (not over 100 lines), you can generally copy it as line if you shoot it same size. You should not attempt to copy it as line work if it requires a great amount of reduction. Reduction may cause the shadow areas to fill in and go solid and may allow parts of the highlight and detail areas to drop out. Enlargement may also produce displeasing results, giving the negative a coarse, screeny appearance.

FINE-LINE DEVELOPER.—You may be able to copy previously printed halftones (or clippings) having more than 100 lines to the inch if you have the camera sharply focused and use fine-line developer.

RESCREENING.—If they do not use the fine-line technique, most camera operators rescreen previously printed halftones if the screen used for the original was finer than 100 lines. It is possible to keep dot patterns at a minimum by reducing the copy 40 to 50 percent or by enlarging it slightly when it is rescreened. It may also help to position the copy at a 15- to 30-degree angle on the copyboard and make the exposure slightly out of focus (fig. 19-16). You can place the

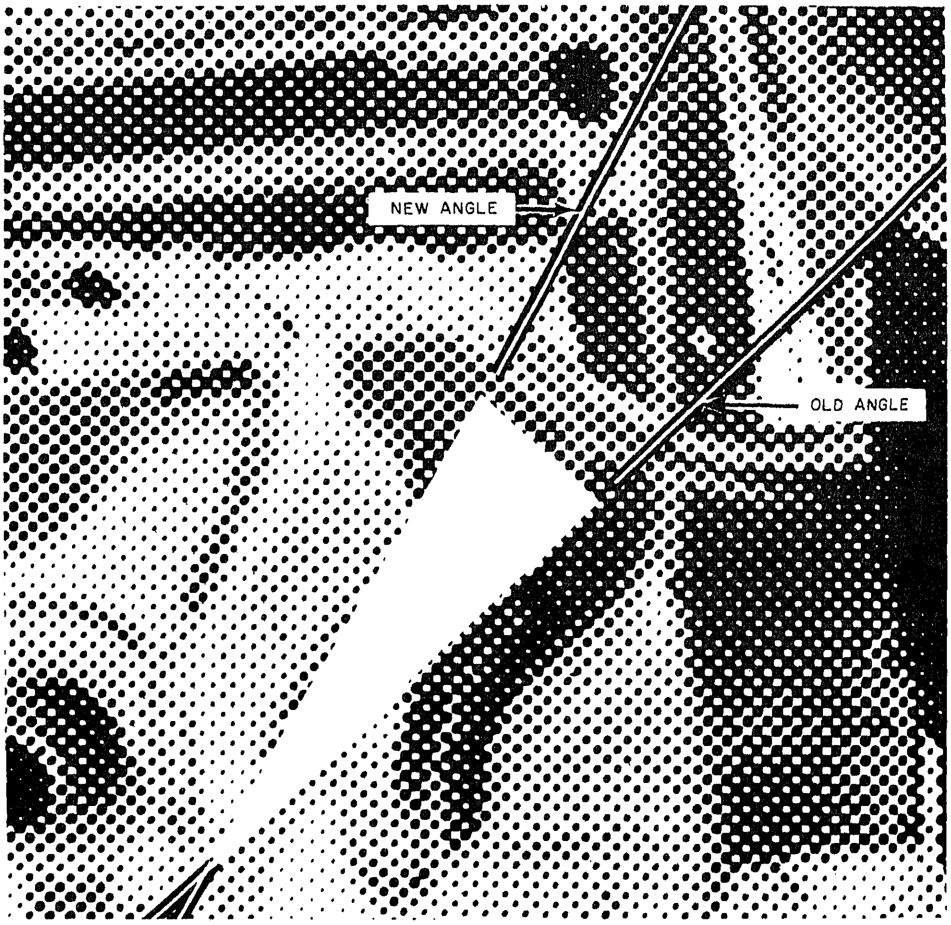

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Figure 19-16.—Establishing a new angle for rescreening.

halftone screen on the copyboard and then rotate the copy beneath it. When the moire design disappears (as the copy is turned), tape the copy in place or mark the position on the copyboard. Before making the exposure, place the screen on the vacuum back in a position corresponding to that used on the copyboard.

Making an exposure slightly out of focus diffuses the dot pattern on the previously printed halftone and causes the image striking the screen to be soft, like continuous-tone copy.

It is also possible to reduce moire by photographing the copy through a screen that is 50 lines finer than that used for the original. However the average shop does not have this range of halftone screens.

PHOTOGRAPHIC PRINTS.—There is another way to reduce moire, but it requires more work. You can eliminate some of the screeny effect by making a continuous-tone negative from the clipping and printing it on matte paper. You can then make your halftone negative directly from the print or you can retouch the print with an airbrush before reshooting it through the halftone screen.

When you retouch the background and highlight areas of a print or clipping, the retouched areas will photograph as new copy. There may still be a slight fuzziness in areas that have not been touched up, however.

WARNOLD PROCESS.—You can produce a continuous-tone negative from a halftone clipping by copying it on a slow-speed continuous-tone film emulsion with a frosted acetate base. This film is used primarily for making positive transparencies from continuous-tone negatives. However, it may also be used in the camera as a negative material. When a same size or slightly reduced shot is made from a 120-line (or finer) halftone clipping, the halftone dots are diffused on the negative to give a continuous-tone effect. The negative can then be printed on photographic paper, and the camera operator can make a halftone negative from this photographic print in the regular manner. By varying this process, you can drop out white or tone backgrounds, and you can also improve the contrast of the image in cases where the clipping is extremely flat.

RESCREENER.—A diffusion filter, known as a rescreener, is sometimes used over the lens in copying halftones which were previously printed. Since the rescreener diffuses the old dot, the camera operator can use it to make continuous-tone negatives from clippings, or you can rescreen the clippings and make halftone negatives without danger of moire.

LINES TOO THICK OR TOO THIN

Thick lines may be due to underexposure, to underdevelopment, or to improper focusing. Improperly mixed developer may also cause this trouble. Thin lines are generally caused by overexposure or overdevelopment.

PINHOLES

Pinholes may be due to dust on the screen, film, or copyboard glass. You should clean the lens with lens cleaning tissue, and clean the copyboard glass with window cleaner and a soft rag. Some camera operators brush the film lightly with a camel hair brush to remove dust before mounting it for the exposure. However, brushing may create static in the film and attract dust—particularly in cold climates.

Pinholes may also be due to air bubbles present when the film is developed. You can prevent this by agitating the film when you immerse it in the developer. In some cases, the pinholes may be due to handling the film with chemicals on your fingers. Always dry your hands carefully before picking up a piece of film.

You can eliminate many pinholes by giving the film a slightly extended development. However, you should watch fine lines to make sure that they do not fill in or fog as development continues.

FLARE SPOTS

Flare spots, or hot spots, are nebulous patches of light caused by internal reflections in the lens. Flare sometimes originates from spots within the lens mount where the blacking has worn off. It may also be caused by reflections of light from one element of the lens to another. The reflected light may bounce from the second element back to the first. And from there, it may be reflected back again to the second, and so on. Part of it may eventually get through to form a flare or ghost on the negative.

A dull black lensboard will help reduce this type of trouble, and a dust-free lens, a lens shade, or a change in the angle or distance of the lights will sometimes decrease it. The lamps must always be positioned so that they will not reflect a surface glare into the lens. Flare can be reduced to a minimum regardless of the positions of the lamps through the use of special lamps equipped with polarized screens and a polarized screen over the lens.

Occasionally, flare may be caused by reflections from other lights in the room. You can check this by turning off the other lights when you make your next exposure.

DUOTONES

Full-color halftone reproductions require the use of four plates. Occasionally, of course, it is necessary to run extra plates in order to reproduce a peculiar shade of color or gold or silver which cannot be successfully duplicated by combining the four basic colors. There are times too, when only two plates are used, and the result is known as a duotone. Duotones vary slightly from regular process work. Two negatives are made from the same black-and-white copy, and the angle of the screen is changed for each shot. The plates from these negatives are then printed in different colors, such as black and green or black and orange.

For best results, there should be 30 degrees difference between the screen angles used for the two negatives. The shadow printer (negative for the black plate) should be shot at the regular 45-degree angle, and the highlight printer (negative for the color plate) should be shot at either a 75- or 15-degree angle. The negative for the black plate is shot in the regular manner, except that instead of using a 90 to 10 dot ratio, the flash is increased slightly to provide a 15-percent shadow dot. The larger dot opens the shadows just enough to allow the color from the color plate to show through. The highlight printer may have no dot at all in the shadow areas and a 75- to 90-percent dot in the highlights.

Camera operators sometimes produce duotones from colored originals, using combinations of masking and filtering to emphasize the tones in the color printer.

Lithographers also use other tricks to get color into plain black-and-white halftones. Sometimes they print a black halftone over a solid block of color. For example, they may run a solid block of blue on the first trip through the press and overprint it on the next trip with a black halftone. This provides a pleasing and interesting effect. They may also get two-color effects from single-color copy by making two halftone negatives and then opaquing out all the color areas on the black negative and all the black areas on the color negative.

In order to get dense shadows and sparkling highlights, Lithographers sometimes make two negatives having different tone scales from the same continuous-tone copy. The plates made from the two negatives are then printed one over the other in the same color of ink to produce the finished print. A 45-degree screen angle is used for the main negative, and this negative is made in the usual manner, except that the flashing time is increased to provide a 15-percent shadow dot. This negative carries all the highlights, most of the detail, and some of the shadows. The second negative is generally shot at a 75-degree screen angle. It receives a detail exposure approximately nine times longer than that used for the first negative, and the flash is about half as long as that used for the main negative. No highlighting exposure is used. When the second negative is developed, it is so contrasty that it resembles a line shot made from continuous-tone copy. There is a complete dropout in the highlights and in some of the middletone areas. When the job is printed with gloss inks on glossy stock, the two images complement one another perfectly and a sparkling reproduction results.

Lithographers also obtain striking effects by shooting continuous-tone copy as line so that a line-drawing effect is produced. This procedure may be used effectively for posters, covers, and so on.

NEGATIVE DIFFICULTIES

Some difficulties can arise as you work with both line and halftone negatives. Therefore, tables 19-1 and 19-2 are provided.

Table 19-1.—Line Negative Difficulties

Difficulty	Cause	Remedy
1. Image does not develop	1. Negative not exposed	1. Check lens, shutter, and camera lamps for failure to operate properly
	2. Oxidized developer (age or contaminated)	2. Replace with fresh developer
	3. Cold developer	3. Heat to 68° F.
2. Develops too slowly	1. Underexposed	1. Check aperture and full coverage of lamps; check filter factor, colored background; increase exposure as necessary
	2. Cold developer	2. Heat to 68°F
	3. Old developer (muddy color, slow action on test strip)	3. Drain developer, clean tray, replace with fresh developer; check water for impurities, use distilled water if necessary
3. Develops too quickly	1. Overexposed	1. Check aperture and lamps; correct position; reduce exposure time
	2. Warm developer	2. Cool to 68°F, if possible; otherwise dilute developer or reduce developing time; use prehardener if necessary
4. Clears too slowly or not at all in fixing bath	1. Old or spent fixer	1. Drain fixer, clean tray, replace with fresh fixer
5. Negative veiled or fogged in clear areas	1. General	1. Reducing bath (Farmer's) may clear fog to produce satisfactory negative. Use single bath for reducing overexposed film; two solution bath for over developed film.
	2. Overexposure	2. Reduce exposure so image first appears in 30-45 seconds (process film at 68°F); reduce with single solution Farmer's Reducer
	3. Overdevelopment	3. Develop only for required time; reduce temperature to 68°F; check for underexposure
	4. Old developer (requires excess developing time)	4. Replace with fresh developer
	5. Reflected light	5. Adjust lights to prevent reflections from lamps or copyboard

Table 19-1.—Line Negative Difficulties—Continued

Difficulty	Cause	Remedy
	6. Light leaks	6. Check camera bellows, lensboard, and darkroom seals
	7. Dirty copyboard glass	7. Clean both sides of glass; keep cameraroom clean and well ventilated
	8. Old or fogged film	8. Replace film; use film before expiration date; check for radiation
6. Uneven development	1. Uneven contact with developer	1. Immerse film quickly and evenly into developer, with emulsion side down
	2. Uneven action of developer	2. Agitate to mix developer and equalize temperature
7. Reticulation or blistering	1. Extreme temperature variation	1. Keep all processing baths at same temperature; use prehardener or hardener bath above 75°F; fan-dry negatives
8. Negative lacks overall density	1. Underexposed or underdeveloped	1. Check aperture and lamps for exposure; check developer for age or adjust development time
9. Negative thin in corners	1. Uneven illumination	1. Increase distance of lamps to copyboard and correct exposure; mount diffusers or reflectors to spread light to edges of copy; stop lens down and increase exposure time.
10. Blurred image	1. Out of focus	1. Check image on ground glass
	2. Camera motion	2. Check for vibration

Table 19-2.—Halftone Negative Difficulties

Difficulty	Cause	Remedy
1. Image develops too slow.	a. Negative underexposed	Check lens diaphragm opening and coverage of lamps. Allow for filter factor, color of background, and halftone screen. Increase exposure time as necessary.
	b. Developer cold	Process at 68° F (20° C).
	c. Developer too weak or too old	Change to fresh developer
2. Negative lacks density	a. Underexposure	See item 1a above
	b. Underdevelopment	Process for recommended time. Increase development time if necessary.
3. Negative thin in corners	a. Illumination not uniform	Increase distance of lights to copy. Use diffusers, or improvise large white cardboard reflectors below and above copyboard to reflect light onto edges of copy.
4. Too much contrast		
a. General	a. Film overexposed	Decrease main exposure.
	b. Bump exposure too long.	Decrease bump exposure time or eliminate.
	c. Developer too harsh	Check solution with an exposed test strip of film. If developer is overactive, dilute it slightly or replace it.
	d. Developer too hot	Keep developing solution at recommended temperature. Cool, if necessary.
	e. Film overdeveloped	Reduce development time.
	f. Insufficient flash	Increase flash exposure or use still development to bring up larger shadow dots.
	g. Too much agitation during development	Use still development during latter stages of development period.
	h. Copy too contrasty	Make all or part of main exposure through a yellow filter or use still development. Increase flash exposure.
b. Highlight dots too large; shadows OK	a. Main exposure too long	Reduce time for main exposure

Table 19-2.—Halftone Negative Difficulties—Continued

Difficulty	Cause	Remedy
	b. Bump exposure too long	Decrease time for bump exposure or deduct time required for bump from time used for main exposure. Or eliminate bump.
	c. Film overdeveloped	Reduce development time and/or use still development.
	d. Developer too harsh or to hot	Cool or dilute with used developer. Shorten development time if necessary.
c. Shadow dots weak; highlight dots OK	a. Insufficient flash	Increase flash exposure or use still development to bring up larger shadow dots.
5. Not enough contrast		
a. General	a. Main exposure too short	Increase main exposure to provide proper highlight dots.
	b. Original copy too flat	Make all or part of main exposure through a magenta filter or use a bump exposure. Use agitation during entire development period. Place screen on vacuum-back with emulsion side facing lens rather than against the film.
	c. Developer too old or too weak	Try fresh solution. If still development is used increase period of agitation to increase contrast in highlight areas.
	d. Developer too cold	Keep developing solution at the recommended temperature.
	e. Flash exposure too long for flat copy	Decrease flash exposure or use rapid agitation during last minute of development.
	f. Negative underdeveloped or underexposed	If all dots are small and transparent negative was underexposed or underdeveloped.
b. Small highlight dots; shadow dots OK	a. Main exposure too short	If highlight dots are small and fuzzy exposure may have been too short and development forced until fog set in.
c. Shadow dots too large	a. Too much flash exposure	Reduce flash exposure and/or use rapid agitation during the last part of development period.
d. Middletones too flat	a. Incorrect main exposure	Expose to move the 50 percent dot, if necessary.

Table 19-2.—Halftone Negative Difficulties—Continued

Difficulty	Cause	Remedy
	b. Underdevelopment	Develop for the recommended time with solution at proper strength and temperature.
6. Blurred image	a. Camera out of focus	Check image on ground glass. See if copyboard, ground glass, and vacuum back are locked in focusing position. Also check scale readings if camera was positioned to scale. In critical focusing check with lens stopped down to that required for exposure because focal length may vary with change in diaphragm opening. If focal length of lens seems to have altered, have qualified operator check for loose inner and outer elements of lens.
	b. Movement (Vibratransmitted to camera may blur fine detail.)	Reduce movement around camera to a minimum. Check shock proof mounting. Check rubber inserts.
	c. Other causes are expansion of copy due to heat from lamps in prolonged exposures, shift of lensboard in changing stops, or slippage or lifting of film on vacuum back.	Check each item.
7. Oblong or fuzzy dots	a. Incorrect exposure	Check exposure time.
	b. Film or screen not perfectly flat on vacuum back	Be sure that vacuum back is clean and free from foreign matter, that film and screen are mounted properly, and that wrinkles have been smoothed out.
8. Blotches	a. Screen not contacting film properly	See item 7b above.
9. Pinholes	a. Screen, film, or copyboard glass dusty	Check each before making another exposure.
	b. Airbells	Airbells may prevent developer from contacting film emulsion. Wet film in plain water before immersing it in developer and/or agitate developer to prevent airbells from forming.

Table 19-2.—Halftone Negative Difficulties—Continued

Difficulty	Cause	Remedy
10. Development not uniform	a. Safelights leaking	Faulty safelight filters can cause areas of the film to fog if the film is left lying open for 4 or 5 minutes. Exposed film should be processed immediately or placed in a lightproof box.
	b. Improper inspection procedures	Heat from the cameraman's hand may cause overdeveloped streaks on the negative. Do not get hand too close to film when examining dot formation with a magnifying glass.
	c. Contamination	Fingers or magnifier contaminated with fixer can cause uneven development. Keep hands clean and do not allow magnifier to touch film.
	d. Failure to immerse film evenly when putting it in developer.	Wet film in plain water or draw it through solution face down when putting it in developer.
11. Flare or hot spots on negative	a. Light reflections from copyboard or camera room area	Use black copyboard; check lighting in camera room.
	b. Reflections from copy	Check positions of lamps and light source distance.
	c. Light leak in bellows	Inspect bellows and repair if necessary.

Note: If negatives fog repeatedly without any apparent explanation or cause, you should report the matter to the Damage Control Assistant. The fog may be due to radiation (x-ray, nuclear, etc.) or to extreme heat.

APPENDIX I

ADDITIONAL REFERENCE READING

Here are some books and manuals that every Lithographer will want to read:

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PRINTING AND LITHOGRAPHIC EQUIPMENT AND INSTRUCTION BOOKS

CAMERAS

FSN/PUB NO.	Title	Manufacturer
0391-LP-123-9000	Camera, lithographic copying, darkroom type, 24″ × 24″, Model WP-300, Panel-control 115V, AC Arc Lamps, 220V AC, 3 PH, Vacuum Pump 110V AC.	Bellingham Chain and Forge Company, Inc.
0391-LP-117-7000	Camera, copying, lithographic darkroom type, 24″ × 30″	Bellingham Chain and Forge Company, Inc.
0391-LP-119-1000	Camera, copying, darkroom type, 24″ × 30″ Model WP-400	Bellingham Chain and Forge Company, Inc.

CAMERAS—CONTINUED

0391-LP-120-8002	Camera, copying, lithographic darkroom type, 24″ × 30″, Capacity 60 cycle vacuum pump 440V AC, 3PH, 115V AC Control panel	Bellingham Chain and Forge Company, Inc.
0391-LP-107-5000	Camera, darkroom type, 16″ × 20″	Consolidated International Equipment and Manufacturing Co.
0385-LP-003-2000	Camera, Special Monotype Directoplate	Lanston Monotype Machine Co.
0385-LP-016-2000	Camera, Vertical Process	The Douthitt Corp.
0391-LP-110-2000	Camera, 16″ × 20″	Consolidated International Equipment and Manufacturing Co.
0391-LP-111-2000	Camera, 24″ × 20″	Consolidated International Equipment and Manufacturing Co.
0391-LP-108-7000	Camera, 24″ × 24″, Model 241	American Type Founders Sales Corp.
0991-LP-014-7000	Camera, Vertical For Reproducing Copy, Meteorite Model	Robertson PhotoMechanix Co.

VACUUM PUMPS

0391-LP-107-3000	Pump, Vacuum, Photographic Use, Model G	Yeomans Bros, Inc.
0991-LP-019-2000	Pump, Vacuum Photographic Use, Model G	Yeomans Bros, Inc.
0347-LP-407-6000	Pump, Vacuum, Photographic Use, 1/2 HP, 115/230V, 1PH, 60 Cycle, 1725 RPM, Model G	Yeomans Bros, Inc.

SINKS

0391-LP-107-6000	Sink, Developing, Photolithographic	Chemco Photo Products, Inc.
0391-LP-115-5000	Sink, Photoprocessing, Temperature Controlled with Refrigerated Storage Cabinet	Heifetz Metal Crafts Co.
0391-LP-115-6000	Sink, Photolithographic Processing Temperature Controlled	Warren Corp.
0391-LP-118-6000	Sink, Photolithographic Processing Temperature Controlled for AC and DC power	Warren Corp.

FSN/PUB NO.	Title	Manufacturer
	SINKS—CONTINUED	
0391-LP-121-6000	Sink, Photographic Processing Temperature Controlled with Refrigerated Storage Cabinet	Bar Ray Products, Inc.
0391-LP-120-1000	Sink, Temperature Controlled for Photolith Processing with Water Circulating System, DC power	Warren Corp.
0385-LP-025-6000	Sink, Photographic Processing PS-100	Bauer Mfg. Co.
0391-LP-116-5000	Sink, Temperature Controlled with Refrigerated Storage Cabinet	Bar Ray Products, Inc.
	PLATE-PROCESSING EQUIPMENT	
0391-LP-114-2000	Processing Machine, Plate, Photolithographic	Rutherford Machinery Co.
0391-LP-120-6000	Printer, rapid, automatic arc control, Model RP 21A	NuArc Co.
0391-LP-119-9000	Frame, Printing Vacuum-type Cabinet	Consolidated International Equipment and Manufacturing Co.
0391-LP-120-2000	Frame, Printing Vacuum	Jos. Gelb Co.
	STITCHERS	
0391-LP-120-0002	Stitcher, Book 1/3 HP, 115/230V DC, 1800 RPM, across line control, Size 0, No. 3P-1200, No. 7	Bostich, Inc.
0391-LP-116-0000	Stitcher, Book, Boston No. 7	Bostich, Inc.
0391-LP-110-4000	Stitcher, Wire, Model N3A3-4	Acme Steel Co.
0391-LP-108-9000	Stitcher, Wire, Model N8	Gitzendanner-Mull Co., Inc.
	PAPER PUNCHING MACHINES	
0322-LP-000-2000	Punching Machine, Multiple, Portland, Foot Powered	American Type Found Sales Corp.

FSN/PUB NO.	Title	Manufacturer

OFFSET PRINTING PRESSES

FSN/PUB NO.	Title	Manufacturer
0991-LP-076-4010	Press, Printing Offset, 23″ × 36″, volume 1	Harris-Seybold Co.
0991-LP-076-4020	Press, Printing, Offset, 23″ × 36″, volume 2	Harris-Seybold Co.
0391-LP-115-9000	Press, Printing, Offset, 23″ × 36″, volume 1	Harris-Seybold Co.
0391-LP-115-9200	Press, Printing, Offset, 23″ × 36″, volume 2	Harris-Seybold Co.
0391-LP-121-2000	Press, Printing, Offset Multilith, Class 1250	Addressograph-Multigraph Corp.
0391-LP-109-3000	Duplicator, Multigraph-Multilith Process	Addressograph-Multigraph Corp.
0991-LP-199-5010	Press Offset, Model L-125-B 19″ × 25″ One Color, OM	Harris Co.

FOLDING MACHINES

FSN/PUB NO.	Title	Manufacturer
0391-LP-145-5000	Folding Machine, Automatic, 4″ × 4″ minimum; 17″ × 28″ maximum sheet size; 115V, 1PH, 60 Cycles, Model FH-6	The Challenge Machinery Co.

PAPER DRILLING MACHINES

FSN/PUB NO.	Title	Manufacturer
0391-LP-120-7001	Drill, Paper, Print Shop, Model E	The Challenge Machinery Co.
0391-LP-111-5000	Drilling Machine, Paper	Super Speed Printing Machinery Co.
0391-LP-116-4000	Drilling Machine, Paper, Single Spindle, N-D Stationary Table Model K4N	Nygren-Dahly Co.

PAPER CUTTERS

FSN/PUB NO.	Title	Manufacturer
0391-LP-122-1000	Cutter, Paper, Guillotine, Hand Lever Operated, Hand Clamp, Size 19 3/8″; Series H; Model 193H	The Challenge Machinery Co.
0391-LP-120-9000	Cutter, Paper, Guillotine 26 1/2″, Hydraulic Series, Model 1265-HB Motor-Elec. 1 1/2 HP, 440V, 3PH, 60 Cycle AC. Model 5KR184AG363 Controller Magnetic 10 HP Max., 440V, 3PH, 60 Cycle. Model IC5130-B46H; Push button Model IC-5844C-201A150	The Challenge Machinery Co.

FSN/PUB NO.	Title	Manufacturer
	PAPER CUTTERS—CONTINUED	
0391-LP-119-0000	Cutter, Paper, Guillotine 36 1/4″, Motor Driven, Hand Clamp 230V DC	The Challenge Machinery Co.
0391-LP-120-3000	Cutter, Paper, Guillotine 36 1/4″, Motor Driven, Hand Clamp	The Challenge Machinery Co.
0391-LP-117-1000	Cutter, Paper, Guillotine, 37″ Motor Direct Hand Clamp	Chandler & Price Co.
0391-LP-122-8000	Cutter, Paper, Guillotine 26 1/2″, Power Clamp, Motor Drive	Chandler & Price Co.
	LINEUP AND REGISTER TABLES	
0391-LP-108-8000	Table, Layout, Photolith, Model RO-P	Craftsman Line-Up Table Corp.
	COMPOSING MACHINES	
0391-LP-120-5000	Varityper Machine, Model 160	Varityper Corp.
0391-LP-152-2000	Varityper, Standard Model F-16	Varityper Corp.
0391-LP-137-1000	Varityper Machine, Operators Manual Standard Models	Varityper Corp.
0391-LP-023-0000	Varityper Headliner Model 800	Varityper Corp.

APPENDIX II

FORMULARY

Gum Arabic solution

acacia crystals	2 lbs
water	58 oz

NOTE: Stir often until crystals dissolve. Filter through cheesecloth. Bring to 14° Baume.

Press fountain stock solution (aluminum)

magnesium nitrate	
or	9 oz av
zinc nitrate	
ammonium dichromate	1 3/4 oz av
phosphoric acid, 85%	5/8 oz
water to make	1 gal

NOTE: For use in fountain, add 2 liquid ounces of stock solution and 3/4 ounce gum arabic solution to 1 gallon of water.

Cleaner, glass

alcohol, grain, 190	1 part
ammonia solution, 5%	1 part

Fixer, film, and paper

ammonium thiosulfate	25 oz
sodium sulfite	2 1/2 oz
acetic acid, 28%	6 oz
boric acid	1 oz
potassium alum	3 oz
water to make	1 gal

NOTE: Discard when clearing time exceeds 6 minutes. Use full strength for films; dilute with equal amount of water for paper. Do not allow prints to remain in bath more than 8 minutes.

Fixer, film, and paper

water (100° - 125°F)	20 oz
sodium thiosulfate (hypo)	8 oz
sodium sulfite	1/2 oz
acetic acid, 28%	1 1/2 oz
boric acid	1/4 oz
potassium alum	1/2 oz
water	1/2 gal

Fixer, film, minimum shrinkage

water	64 oz
sodium thiosulfate (hypo)	32 oz
potassium metabisulfite	4 oz
water to make	1 gal

Developer, continuous tone, paper, and film (D-72)

water (100° - 125°F)	16 oz
Elon (Metol)	45 gr
sodium sulfite	1 1/2 oz
hydroquinone	175 gr
sodium carbonate	2 1/4 oz
potassium bromide	27 gr
water to make	32 oz

NOTE: This developer is of the same type as Kodak Dektol and may be used as such: Use: 1 part solution to 1 part water.

Developer, contrast, line-halftone film (D-85)

water (90°F)	64 oz
sodium sulfite	4 oz

Developer, contrast, line-halftone film (D-85)—Continued

paraformaldehyde	1 oz
potassium metabisulfite	150 gr
boric acid (crystals)	3 oz
potassium metabisulfite	90 gr
water to make	1 gal

NOTE: Age 2 hours before using. Develop 2 minutes.

Developer, high contrast, line-halftone film (D-8)

water (90° - 110°F)	96 oz
sodium sulfite	12 oz
hydroquinone	6 oz
sodium hydroxide	5 oz
potassium bromide	4 oz
water to make	1 gal

NOTE: Use 2 parts developer to 1 part water. Develop 2 minutes.

Stop bath, film

acetic acid, 28%	4 oz
water	32 oz
or	
vinegar, 50 grain strength	15 oz
water	32 oz

Prehardener. For negative development at high temperatures.

(Photomechanical films usually have prehardened emulsions.) Immerse negative for 2 to 3 minutes, wash for 1 to 2 minutes in water, then develop normally.

formalin (40% formaldehyde)	1 fl oz
sodium carbonate (desiccated)	1/2 oz
water	1 gal

Intensifier (Monckhoven). Bleach negative thoroughly in solution A; then wash 2 minutes in running water and place in blackening solution B. Wash and dry negative following intensification.

Solution A

potassium bromide	3/4 oz
mercuric chloride	3/4 oz
water to make	1 qt

Solution B

potassium or sodium cyanide	3/4 oz
silver nitrate	3/4 oz
water to make	3/4 qt

In preparing solution B, dissolve silver nitrate and potassium or sodium cyanide in separate portions of water. Then add the silver solution to the cyanide solution until precipitate formed is almost completely dissolved. Allow to age for an hour or more before using.

Farmer's Reducer - single solution

Solution A

potassium ferricyanide	1 1/4 oz
water to make	16 oz

Solution B

sodium thiosulfate	16 oz
water to make	1/2 gal

NOTE: Use 1 part A and 4 parts B to 16 ounces water.

Farmer's Reducer - two solution

Solution A

potassium ferricyanide	1/4 oz
water to make	32 oz

Solution B

sodium thiosulfate	6 3/4 oz
water to make	32 oz

NOTE: Use of two solution gives overall proportional reduction.

Volume

2 pints = 1 quart

4 quarts = 1 gallon

16 ounces = 1 pint

1000 cubic centimeters OR 1000 milliliters = 1 liter

1 ounce = 29.6 cc or mil

1 quart = 946 cc or mil

Optics

1. Foot candles of illumination =

$$\frac{\text{candle power of light}}{\text{distance from object to light squared}}$$

2. Magnification $= \dfrac{\text{height (image)}}{\text{height (object)}}$

3. Focal length $= \dfrac{\text{distance from film to copy (with camera focused at same size)}}{4}$

Formula for dilution

To reduce the strength of a given solution:

1. Subtract the percentage strength of the solution desired from the percentage strength of the solution to be diluted. Let this remainder be "X."
2. Subtract the percentage strength of the diluting solution (water is 0%) from the percentage strength of the solution required. Let this remainder be "Y."
3. Now, "X" parts of the strong solution mixed with "Y" parts of the diluting solution will give the correct percentage strength of the solution required.

In American photographic practice, solids are weighed by either the Avoirdupois or the Metric system and liquids are measured correspondingly by U. S. Liquid or Metric measure. The following tables give all the equivalent values required for converting photographic formulas from one system to the other:

Avoirdupois to Metric Weight

Pounds	Ounces	Grains	Grams	Kilograms
1	16	7000	453.6	0.4536
0.0625	1	437.5	28.35	0.02835
		1	0.0648	
	0.03527	15.43	1	0.001
2.205	35.27	15430	1000	1

U. S. Liquid to Metric Measure

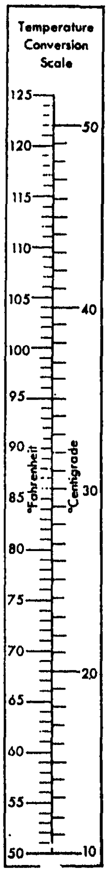
Gallons	Quarts	Ounces (Fluid)	Drams (Fluid)	Cubic Centimeters	Liters
1	4	128	1024	3785	3.785
0.25	1	32	256	946.3	0.9463
		1	8	29.57	0.02957
		0.125	1(60 mins.)	3.697	0.003697
		0.03381	0.2705	1	0.001
0.2642	1.057	33.81	270.5	1000	1

Conversion Factors

Grains per 32 fluid oz. multiplied by 0.06847 = grams per liter
Ounces per 32 fluid oz. multiplied by 29.96 = grams per liter
Pounds per 32 fluid oz. multiplied by 479.3 = grams per liter

Grams per liter multiplied by 14.60 = grains per 32 fluid oz.
Grams per liter multiplied by 0.03338 = ounces per 32 fluid oz.
Grams per liter multiplied by 0.002086 = pounds per 32 fluid oz.

Ounces (fluid) per 32 oz. multiplied by 31.25 = cubic centimeters per liter.
Cubic centimeters per liter multiplied by 0.032 = ounces (fluid) per 32 oz.
cm. × .3937 = inches   inches × 2.5400 = cm.



Photographic formulas equivalent values.

Temperature Conversion Table

To convert either Fahrenheit or Celsius temperatures, follow the center column to the desir temperature, then read the conversion temperature in the "F" or "C" column. For examp 20°F equals -6.7°C and 20°C equals 68.0°F.

°C	°	°F	°C	°	°F	°C	°	°F
- 28.9	- 20	- 4.8	- 6.1	21	69.8	16.1	61	141
- 28.3	- 19	- 2.2	- 5.6	22	71.6	16.7	62	143
- 27.8	- 18	- 0.4	- 5.0	23	73.4	17.2	63	145
- 27.2	- 17	1.4	- 4.4	24	75.2	17.8	64	147
- 26.7	- 16	3.2	- 3.9	25	77.0	18.3	65	149
- 26.1	- 15	5.0	- 3.3	26	78.8	18.9	66	150
- 25.6	- 14	6.8	- 2.8	27	80.6	19.4	67	152
- 25.0	- 13	8.6	- 2.2	28	82.4	20.0	68	154
- 24.4	- 12	10.4	- 1.7	29	84.2	20.6	69	156
- 23.9	- 11	12.2	- 1.1	30	86.0	21.1	70	158
- 23.3	- 10	14.0	- 0.6	31	87.8	21.7	71	159
- 22.8	- 9	15.8	0.0	32	89.6	22.2	72	161
- 22.2	- 8	17.6	0.6	33	91.4	22.8	73	163
- 21.7	- 7	19.4	1.1	34	93.2	23.3	74	165
- 21.1	- 6	21.2	1.7	35	95.0	23.9	75	167
- 20.6	- 5	23.0	2.2	36	96.8	24.4	76	168
- 20.0	- 4	24.8	2.8	37	98.6	25.0	77	170
- 19.4	- 3	26.6	3.3	38	100.4	25.6	78	172
- 18.9	- 2	28.4	3.9	39	102.2	26.1	79	174
- 18.3	- 1	30.2	4.4	40	104.0	26.7	80	176
- 17.8	0	32.0	5.0	41	105.8	27.2	81	177
- 17.2	1	33.8	5.6	42	107.6	27.8	82	179
- 16.7	2	35.6	6.1	43	109.4	28.3	83	181
- 16.1	3	37.4	6.7	44	111.2	28.9	84	183
- 15.6	4	39.2	7.2	45	113.0	29.4	85	185
- 15.0	5	41.0	7.8	46	114.8	30.0	86	186
- 14.4	6	42.8	8.3	47	116.6	30.6	87	188
- 13.9	7	44.6	8.9	48	118.4	31.1	88	190
- 13.3	8	46.4	9.4	49	120.2	31.7	89	192
- 12.8	9	48.2	10.0	50	122.0	32.2	90	194
- 12.2	10	50.0	10.6	51	123.8	32.8	91	195
- 11.7	11	51.8	11.1	52	125.6	33.3	92	197
- 11.1	12	53.6	11.7	53	127.4	33.9	93	199
- 10.6	13	55.4	12.2	54	129.2	34.4	94	201
- 10.0	14	57.2	12.8	55	131.0	35.0	95	203
- 9.4	15	59.0	13.3	56	132.8	35.6	96	204
- 8.9	16	60.8	13.9	57	134.6	36.1	97	206
- 8.3	17	62.6	14.4	58	136.4	36.7	98	208
- 7.8	18	64.4	15.0	59	138.2	37.2	99	210
- 7.2	19	66.2	15.6	60	140.0	37.8	100	212
- 6.7	20	68.0						

Temperature Conversion Table—Continued

°C	°	°F	°C	°	°F	°C	°	°F
38.3	101	213.8	60.6	141	285.8	82.8	181	357.8
38.9	102	215.6	61.1	142	287.6	83.3	182	359.6
39.4	103	217.4	61.7	143	289.4	83.9	183	361.4
40.0	104	219.2	62.2	144	291.2	84.4	184	363.2
40.6	105	221.0	62.8	145	293.0	85.0	185	365.0
41.1	106	222.8	63.3	146	294.8	85.6	186	366.8
41.7	107	224.6	63.9	147	296.6	86.1	187	368.6
42.2	108	226.4	64.4	148	298.4	86.7	188	370.4
42.8	109	228.2	65.0	149	300.2	87.2	189	372.2
43.3	110	230.0	65.6	150	302.0	87.8	190	374.0
43.9	111	231.8	66.1	151	303.8	88.3	191	375.8
44.4	112	233.6	66.7	152	305.6	88.9	192	377.6
45.0	113	235.4	67.2	153	307.4	89.4	193	379.4
45.6	114	237.2	67.8	154	309.2	90.0	194	381.2
46.1	115	239.0	68.3	155	311.0	90.6	195	383.0
46.7	116	240.8	68.9	156	312.8	91.1	196	384.8
47.2	117	242.6	69.4	157	314.6	91.7	197	386.6
47.8	118	244.4	70.0	158	316.4	92.2	198	388.4
48.3	119	246.2	70.6	159	318.2	92.8	199	390.2
48.9	120	248.0	71.1	160	320.0	93.3	200	392.0
49.4	121	249.8	71.7	161	321.8	93.9	201	393.8
50.0	122	251.6	72.2	162	323.6	94.4	202	395.6
50.6	123	253.4	72.8	163	325.4	95.0	203	397.4
51.1	124	255.2	73.3	164	327.2	95.6	204	399.2
51.7	125	257.0	73.9	165	329.0	96.1	205	401.0
52.2	126	258.8	74.4	166	330.8	96.7	206	402.8
52.8	127	260.6	75.0	167	332.6	97.2	207	404.6
53.3	128	262.4	75.6	168	334.4	97.8	208	406.4
53.9	129	264.2	76.1	169	336.2	98.3	209	408.2
54.4	130	266.0	76.7	170	338.0	98.9	210	410.0
55.0	131	267.8	77.2	171	339.8	99.4	211	411.8
55.6	132	269.6	77.8	172	341.6	100.0	212	413.6
56.1	133	271.4	78.3	173	343.4	100.6	213	415.4
56.7	134	273.2	78.9	174	345.2	101.1	214	417.2
57.2	135	275.0	79.4	175	347.0	101.7	215	419.0
57.8	136	276.8	80.0	176	348.8	102.2	216	420.8
58.3	137	278.6	80.6	177	350.6	102.8	217	422.6
58.9	138	280.4	81.1	178	352.4	103.3	218	424.4
59.4	139	282.2	81.6	179	354.2	103.9	219	426.2
60.0	140	284.0	82.2	180	356.0	104.4	220	428.0

Formula for converting Fahrenheit to Celsius: $^\circ\mathrm{F} - 32 \times \frac{5}{9} = {}^\circ\mathrm{C}$

Formula for converting Celsius to Fahrenheit: $^\circ\mathrm{C} \times \frac{9}{5} + 32 = {}^\circ\mathrm{F}$

APPENDIX III

THE HYDROMETER

A Baume hydrometer, like the one shown in figure AIII-1, is used for measuring the density of a solution. It consists of a sealed glass tube weighted at the bottom. It is calibrated along the stem so that when it is placed in plain water, it sinks to the 0° mark. If gum arabic or similar materials are added to the water, the density of the solution is increased. This forces the hydrometer upward. A reading must be taken to determine the density of the new solution. (The hydrometer is calibrated in tenths of a degree to provide for very accurate readings.) Conversely, if you add water to a concentrated solution, the density is decreased and the hydrometer sinks deeper into the solution. Since density varies with the temperature of the solution, all readings should be made at a given temperature. The recommended temperature for a Baume hydrometer reading is 77 °F. It is always easier to prepare a concentrated solution and then bring it down to the proper consistency by adding water, than it is to prepare a dilute solution and then concentrate it.

Another type of hydrometer, known as a specific gravity hydrometer, is sometimes used in lithographic work. This hydrometer differs from a Baume hydrometer in the method of calibration. You can find the corresponding readings for specific gravity hydrometers by consulting the Baume-Specific Gravity Comparison Scale shown below.

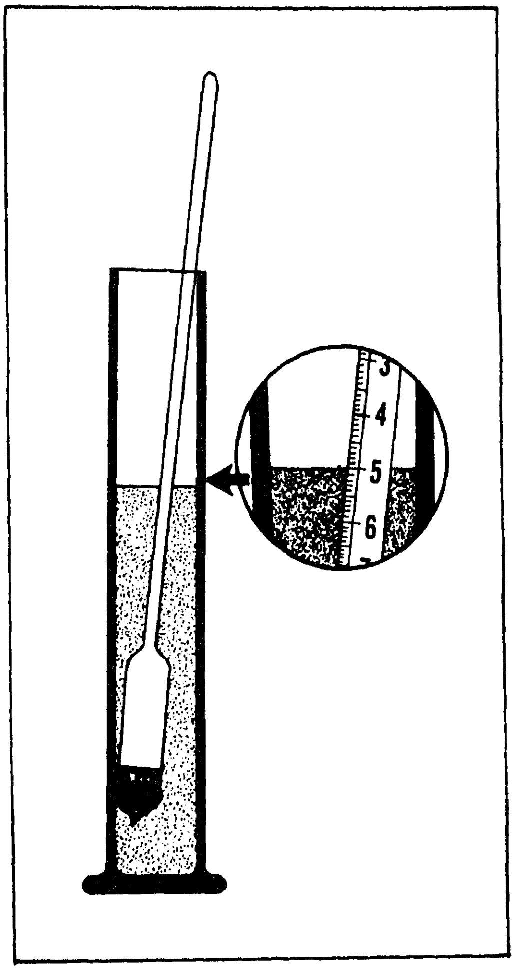


Figure AIII-1.—The hydrometer.

Baume—Specific Gravity comparison scale.

Degrees Baume	Specific Gravity	Degrees Baume	Specific Gravity
5.1	1.0365	6.4	1.0462
5.2	1.0372	6.5	1.0469
5.3	1.0379	6.6	1.0477
5.4	1.0387	6.7	1.0484
5.5	1.0394	6.8	1.0492
5.6	1.0402	6.9	1.0500
5.7	1.0409	7.0	1.0507
5.8	1.0417	7.1	1.0515
5.9	1.0424	7.2	1.0522
6.0	1.0432	7.3	1.0530
6.1	1.0439	7.4	1.0538
6.2	1.0447	7.5	1.0545
6.3	1.0454		

The formulas used to convert between Baume and Specific Gravity mathematically are shown below.

a. Heavier than water

$$\text{Specific Gravity} = \frac{145}{145 - \text{degrees Baume}}$$

$$\text{Baume} = 145 - \frac{145}{\text{Specific gravity}}$$

b. Lighter than water

$$\text{Baume} = \frac{140}{\text{Specific gravity}} - 130$$

$$\text{Specific gravity} = \frac{140}{130 + \text{Baume}}$$

APPENDIX IV

MAINTENANCE OF LITHOGRAPHIC EQUIPMENT

Proper lubrication is an important step in maintenance of your equipment. It prolongs the life of equipment that has movable parts. You should apply red paint to the oil holes on equipment so that you will not overlook them. Depending on its use, you should oil each piece of equipment daily with SAE No. 20 oil. Wipe off the excess oil with a rag. Do not let the oil run down the sides of the equipment. Check all oil reservoirs on vacuum pumps to see that they contain sufficient oil.

Below you will find some general maintenance procedures which should be performed on selected lithographic equipment. However, you should also consult the manuals for each piece of equipment in your shop for complete maintenance procedures.

VACUUM FRAMES

1. Clean glass every evening or more often if necessary. Use soft rags and commercial cleaner or ammonia water. Never use dirty rags or razor blades as they may scratch the glass.
2. Check vacuum pump reservoirs for sufficient oil.
3. Oil all moving parts, hinges, clamps, motors, and so forth, regularly.
4. Clean gaskets and check for glaze.

SINKS AND TRAY COOLERS

1. Check all water valves for leaking, sticking, or rusting.
2. Check all chemicals that should be near sinks.
3. Check and oil motors and pumps on tray coolers.
4. Clean trays with potassium permanganate.
5. Check spray pipes for leaks and proper distribution of water.
6. Remove racks and check drains for proper working condition.
7. Remove all dirt or waste from in and under sinks.

FANS

1. Oil all fan motors daily or as often as required.
2. Clean dirt and excess oil from fans.
3. Check wiring connections periodically.

CAMERAS

1. Brush copyboard felt with foxtail.
2. Clean copyboard glass with cleaner fluid and soft rags. Rags must be clean and free of lint, buttons, and hooks.
3. Clean inside and outside of bellows with foxtail.
4. Clean ground glass with cleaner and soft, lint-free rags.
5. Clean and oil all gears with light oil. Remove all excess oil.
6. Oil and grease vacuum pumps and motors.
7. Clean lens with lens cleaner and lens tissue.
8. Dust contact screens with soft photo chamois before storing them away. Clean with the special organic chemical supplies by the manufacturer.

FILTERS AND SAFELIGHTS

1. Check wattage of bulbs in safelights.
2. Clean all filters with glass cleaner and soft rags.
3. Check all filters for scratches or breaks.

ENLARGERS

1. Remove copy frame and clean with a mild cleaner and soft rags.
2. Remove lens and clean with lens cleaner and lens tissue.
3. Oil vertical slide shaft with light oil or vaseline. Remove excess oil.
4. Check electrical connections and bulbs.
5. Clean all dimension slides of rust or corrosion.

CAMERA LUBRICATION

Process cameras require little lubrication except for the main components, such as the main screw drive, chain assemblies, ground glass mechanism, swiveling and revolving bearings, and so on. You can oil these components with SAE No. 10 motor oil.

Keep the automatic oiling device on the vacuum pump filled with No. 20 SAE oil. The ball bearings of some camera vacuum pumps have screw cap oilers which should be oiled every 40 hours of running time. Screw cap oilers should be kept tight at all times. This oiler feeds only when the pump is in operation and its proper feed rate is set by the pump manufacturer.

CLEANING

At the end of each week, you should clean the lamp reflectors, bellows, and all internal parts of the camera with a dry clean cloth. Clean all glass components, such as the copyboard glass and ground glass with a clean cloth to remove dirt, dust, and oil film. If necessary, you can go over these surfaces with a soft rag moistened with a mixture of ammonia and water or a dilute solution of acetic acid and alcohol. Never use dirty rags or razor blades to clean the glass as they might scratch its surface. If it is necessary to scrape the glass, use your fingernail or a wooden or plastic scraper.

DAILY INSPECTION

You or someone in your shop should inspect the camera at the beginning of each day. Check the lenses for dirt and dust and clean with lens cleaning tissue and lens cleaner, if necessary.

Check to see that the vacuum back, ground glass, and copyboard are free from dirt or other foreign matter. Check the vacuum and electrical connections. Leaky vacuum or defective electrical connections may cause improper illumination or slippage of the copy, film, or contact screen.

500-HOUR INSPECTION

You should conduct a thorough visual inspection of the camera after every 500 hours of operation or every 6 months, whichever occurs first. During this inspection, you should check the bellows and darkroom wall light seal for holes, cracks, or tears which might admit the light.

Check the camera bed, chains, lamps supports, and other parts for corrosion. Check the drive mechanism for ease of movement and evidence of foreign matter. Check to see that the vacuum back fits properly and seals out the light.

You should also check the condition of the lamp holders, copyboard, and ground glass. You should check the vacuum system for possible leaks.

Check all points of movement of the copyboard, lensboard, and camera back assemblies for wear. Check the lens shutter to see that it is operating properly.

THE 16-INCH BY 20-INCH CONSOLIDATED CAMERA

The following paragraphs provide information on maintenance, repair, and replacement of those parts of the 16-inch by 20-inch consolidated camera which are considered to be repairable by printshop personnel.

GROUND GLASS

If the ground glass breaks, you simply remove the plates and screws which hold it in place. Remove the broken glass and insert a new one. Then secure it with the plates and screws.

COPYBOARD COVER GLASS

If the copyboard cover glass breaks, you can replace it with the frame attached to the copyboard assembly. However, it is recommended that the frame be removed from the assembly during this operation. You can detach the frame by retracting the four hinge pins to free it. Plac the broken glass.

Install the felt pads between the new glass and the clip standard and secure it in the frame with the clips and screws. Reconnect the frame to the base by placing it in the proper position over the lower copyboard frame. Pull out on the four hinge pins and position the frame so that the hinge pins will enter the lower halves of the hinges when they are released.

VACUUM BLANKET

With prolonged use, the copyboard blanket may become damaged and allow leakage. To replace a damaged blanket, loosen the vacuum hose connection at the lower right rear of the copyboard and swing the copyboard to its horizontal position. Open the copyboard glass and remove the blanket by pulling off the clips along the edges. Position the new blanket on the copyboard and secure it with the clips. Finally, reattach the vacuum hose connection.

VACUUM HOSE AND CLAMPS

If the vacuum hose is damaged and leaking, you can remove it by unfastening the clamps which hold it on the valves. Install a new hose and secure it with the clamps. If the clamps are damaged, install new ones at the same time.

LOCK SPRINGS

The locks on the copyboard cover, vacuum back, and ground glass frame are spring loaded. To repair one of these locks, screw the lock knob free of the lockpin, being careful that the lockpin and spring do not fall out when the lock knob is removed. Insert a new lock spring in the lock opening and then install the lockpin. Finally screw the lock knob back into the threaded opening of the lockpin.

HANDWHEELS

It is seldom necessary to replace the handwheels, but if a replacement is required, you should remove the taper pins securing the handwheels to the shaft and replace the damaged wheel with a new one. Insert the taper pins to lock the new wheel in position.

It is seldom necessary to replace the copyboard roller bearings. However, if replacement is necessary, you should loosen the screws and remove the front and back plates first. Next, remove the securing nut and pull the bearing bolt out far enough to permit the removal of the bearing. Slip the new bearing over the bolt and retighten the nut. It may be necessary to lift the corner of the copyboard assembly to insert the new bearing. You should replace only one bearing at a time. Do not try to replace them all simultaneously.

LAMP CARRIER BEARINGS AND CLAMP ASSEMBLIES

If the lamp carrier bearings and brake linings in the clamp assemblies wear and require replacement, you should loosen the lock securing the lamp holder post and lift out the post (with the lamps attached). Then remove the taper pins in the lock assembly to permit the lock components to be separated from the carriage housing. Loosen the four bolts that secure the fixed arm to the carriage housing and remove the fixed arm. Separate the carriage housing halves by removing the six screws in the sides, the two eccentric screws, and the four nuts. When separating the housings, be careful to retain the four roller bearings inside. Check the roller and bearing assemblies and replace worn parts, as necessary.

You should also check the brake lining of the carriage housing to see if replacement is required. If it is, remove the setscrew and pin and replace with a new clamp assembly.

To reassemble, insert the two screws in the upper roller openings in the carriage housing and the two eccentric screws in the lower carriage housing openings. Position two roller assemblies over the eccentric screws. Place the half of the carriage housing which contains the roller assemblies against the monorail in such a manner that the grooves in the rollers contain the lower edge of the monorail. Install the two upper rollers in a similar manner on the top of the rail and retain with the two screws.

Attach the other half of the carriage housing by positioning it over the roller screws and replacing the four nuts. Then insert the four screws and tighten evenly. Adjust the eccentric screws so that the carriage will move freely and evenly along the rail.

Next, fasten the fixed arm to the carriage with the remaining four screws. Replace the lock mechanism after positioning the clamps and pin to secure it in position. Check the locking action at this point to ensure that the locking mechanism was properly replaced. Finally, replace the lamp post assemblies with the lamps attached and lock them in position.

SHUTTER

To replace the camera shutter, open the ground glass and vacuum back and move the lensboard as near to the back of the camera as possible. Remove the screws which secure the shutter to the lensboard assembly and remove the shutter. Attach the new shutter to the lensboard with the screws.

VACUUM BACK VALVE SPRINGS

If the vacuum back control valve seems to be leaking or is difficult to turn, the valve springs may have lost their tension or they may be broken. To replace these springs, remove the screws securing the valve plate and lift off the plate and valve, being careful to retain the springs and balls located between the valve and the plate.

Place the valve knob up on a flat surface and insert the replacement springs and balls in the valve openings. Place the valve plate over the balls and press down firmly until the knob can be grasped so that the valve plate will remain in contact with the balls. Insert the valve in the opening in the vacuum back and align the valve plate against the vacuum back. Secure it in position by replacing the screws.

SETTING THE CAMERA TAPES

Although camera construction varies somewhat, the method of setting the tapes is similar for all cameras.

Each camera tape is attached to a spring at the camera back. At the front, each is attached to the copyboard or lensboards with a slip clamp. With use, it is possible that the tapes may slip and require realignment. If this happens, you should take a sheet of white paper exactly 12 inches square and accurately rule it with inked vertical and horizontal lines. These lines should be drawn at 1-inch intervals so that they crisscross each other to form 1-inch squares. Center this sheet of paper on your copyboard. (Some camera operators place a 1-foot ruler on the copyboard instead of the ruled sheet.) Open your lens to the maximum apperture opening and adjust the camera for a one-to-one shot. Measure the dimensions on the ground glass with a second ruler. When the dimensions of the image correspond exactly with those of the copy, you will know that the camera is set for a same-size shot. Now, refer to the dial focusing scale that comes with the camera. Set the dial for a one-to-one shot to determine the correct setting for your tapes when the camera is at this position. Compare this setting with the actual tape reading. If the actual reading is off, loosen the slip clamps and adjust the tapes until they read correctly for a one-to-one shot. Next, move the camera until the image is reduced 50%. Check the dimensions of the squares on the ground glass. They should be exactly 1/2-inch square. Check your dial focusing scale to see what tape setting is required for a 50-percent reduction. Check this against your actual tape reading, and adjust the tapes again if necessary. Next, go to an enlargement of 200% and check the tapes as before, adjusting them if necessary. Finally, bring the camera back to a one-to-one setting and make a final check. The tape reading should be correct at this point. If it is not, repeat the process.

LINEUP AND RETOUCHING TABLES

1. Check fluorescent light for proper lighting.
2. Check wire connections.
3. Clean glass with window cleaner and soft rags.
4. Check all retouching tools and fluids. Replace as necessary.
5. Clean reflectors and paint if necessary.
6. Oil moving parts.

TYPEWRITERS AND COMPOSING MACHINES

1. Oil all moving parts with light machine oil.
2. Remove excess oil with soft cloth.
3. Remove all dirt and dust. Clean the keyboard with a soft brush and type cleaner. Blow dust from the machine with compressed air or bellows.
4. Check electric cord connections.
5. Clean typewriter and composing machine type with alcohol or type cleaner and brush.
6. Check ribbons.

DRAFTING EQUIPMENT

1. Clean T-squares with alcohol. Tighten all screws.
2. Clean triangles with alcohol.
3. Clean and sharpen stripping knives on oilstones.
4. Clean brushes thoroughly in warm water. Place brushes in jar with bristles up.
5. Clean pen points and lettering equipment with proper solvent.
6. Sharpen or replace engraving needles.

PRESSES AND OTHER EQUIPMENT

Maintenance procedures for presses and other equipment not listed here will be found in the chapters dealing with the specific equipment or in the applicable manufacturer's instruction manual.

APPENDIX V

PRESSROOM TROUBLES

Presses don't act up or malfunction just to make it tough on press operators. There are logical reasons for everything that goes wrong. It is not usually difficult to correct troubles once you have found the cause. But this is sometimes like hunting for a needle in a haystack, especially for a beginner. Some problems may be caused by a number of conditions. Tracing the trouble to its source is less difficult for an experienced press operator because one eventually develops an almost uncanny instinct about such things. Yet, even an experienced press operator can't always put a finger on the source of the trouble immediately.

Most press troubles are caused by little things. Examples are incorrect packing behind the plate or blanket, poor ink distribution, and improper balance between ink and water. Poor plates will also result in printing problems and so will excessive pressure on the ink and dampening rollers. You will soon see just how each of these factors affects the quality of the print.

INK TROUBLES

Most inks are prepared for average conditions. You can usually use the ink directly from the container, except when you are doing the following:

1. Adding drier
2. Mixing colors
3. Lightening colors (by addition of laketine or a tint of the same color)
4. Changing the consistency of the ink to suit the paper (adding a thin varnish to reduce tack or adding a body varnish to build up the tack)

LENGTH AND TACK

Length has to do with the fluidity or flow of the ink. A long ink is one that is stringy and free flowing like molasses. A short ink is one with a stiff, lardlike consistency. Length and tack do not necessarily go hand in hand. You may have a short ink with a good deal of tack or a short ink with very little tack. The same is true of long inks.

Tack has to do with the stickiness of the ink. When your ink does not have enough tack, the ink will not transfer from the rollers to the plate or from the plate to the offset blanket. When your ink has too much tack, it may damage the blanket and cause the paper to pick (stick to the blanket).

Length and tack vary with the temperature of the room and the press. They also change when the ink is distributed or worked out on the rollers. Moisture from the dampeners also reduces tack. At the beginning of a new pressrun, the ink may be so stiff that it will actually affect the speed of the press rotation, but it will become more pliable as the pressrun continues.

The consistency of the ink is determined by the amount and type of vehicle that it contains and the nature of the pigment that is being used. These factors also affect the drying qualities of the ink.

Thin inks dry mainly by absorption, and you can generally use the ink just as it comes from the can if the paper is smooth and absorbent. In some cases, however, you must modify the ink to suit the paper. You can do this by the addition of driers and varnishes.

Driers come in many types, but cobalt, lead, and manganese are among those most generally used. These driers are sometimes used in combination since each has different drying qualities. Cobalts are fast-surface driers and are used mainly with blacks and dark-colored inks. Paste driers of lead and manganese dry evenly throughout the ink and are used with all colors. Powdered driers are sometimes used with colored inks since some paste driers tend to lighten ink colors.

Varnishes come in 10 different thicknesses, ranging from No. 00000 (thinnest) to No. 8 (thickest). The thicker varnishes are called "body gum."

You should add a little drier and run the ink as stiff as possible when you are working with ledgers and rag-content bond papers. Besides producing well-defined images, stiff inks are less likely to scum the plate or to become waterlogged during the pressrun. Although colors, such as black, blue, and dark green, run reasonably well, colors, such as red, orange, and yellow, often acquire a texture that resembles putty if they do not contain the proper vehicle.

If the ink is too stiff, it may cause the sheets of paper to stick or pick. It may also cause uneven distribution. You can soften the ink, when necessary, by adding a little No. 1 varnish. A little varnish goes a long way, so don't use too much. The thinner varnishes cause the ink to be greasy and may cause it to bleed. In addition, thinner varnishes dull the print and retard drying. An excess of thin varnish sometimes causes the sheets of paper to offset and stick together.

The ink should be reasonably stiff when you are working with coated paper stocks. However, coated paper stocks are more susceptible to picking than the rag-content bonds, and they may require that you thin the ink and run it soupier so that it will have less tack.

You can use soft ink when you are working with sulphite bond papers and uncoated stocks. Little drier will be needed since these paper stocks are absorbent. Soft inks do tend to be greasy, so it may be necessary to reduce your printing pressure or to increase the strength of your fountain solution when you are working with them. Many press operators reduce the impression pressure instead of using a stronger fountain solution. This is because excess acid is liable to damage the image on the plate or to cause the ink to waterlog.

If the ink is too greasy, you can stiffen it with No. 5 varnish. If it tends to pile, use No. 7 or No. 8 varnish. Add the varnish carefully because too much may cause the ink to become puttylike and back away from the fountain roller.

REDUCING THE STRENGTH (COLOR) OF INK

You can lighten the color of ink (reduce its strength) by mixing it with white or a lighter tint of the same color. Mixing the colored ink with alumina hydrate or laketine will also reduce its strength. Press operators often use laketine, but the result is brighter and more lively when the ink

change its consistency. If you reduce the strength of the ink too far, it will be necessary to carry too much of it on the rollers in order to get the desired color. This leads to other difficulties, as you will see later.

PLATE DOES NOT TAKE INK

If the image does not ink up during the makeready operations, you should check your form rollers to see if they are contacting the plate properly. You can check the roller-to-plate contact by stopping the press and dropping the inked rollers against a dry, gummed plate packed to the proper height. Then raise the rollers and examine the inked streaks left on the plate.

When you are running a large press or conventional grained plates, the form roller next to the water fountain should leave an inked ribbon one-fourth of an inch wide. The streaks left by the other form rollers should be progressively narrower, with the last roller (the one nearest the delivery end of the press) producing a one-eighth of an inch streak. Presensitized plates require less roller and printing pressure. If you are running these plates, the ink form rollers should be set to leave streaks ranging in width from one-eighth to three-sixteenth inch when they are dropped against the plate. As a check, always consult your operator's manual for the particular press you are operating when checking roller pressures.

BLINDNESS

Offset plates will sometimes go blind or refuse to accept ink in the image areas. If a plate goes blind during a pressrun, you may be using too much roller pressure. Another possibility is there is too much squeeze or pressure between the blanket and plate. A third possible cause for this problem is the fountain solution may contain too much acid or gum. If the plate is blind at the start of the pressrun, it is likely that something went wrong in the plate-making operation and the image is no longer receptive to the grease in the ink. If the blindness is due to thick gumming, you may be able to bring the image up by lifting the ink rollers and running the press until the image works clean. Repeat this procedure if necessary.

Presensitized plates may refuse to take ink if they are not treated properly. For example, some types of presensitized plates will go totally blind or blind in spots if the lacquer is not properly running 100 or more waste sheets through the press will bring up the image. If this doesn't help, you must stop the press, gum the plate, wash out the image, and then rub it up with ink.

Underexposure, underdevelopment, too much printing pressure, and the careless or excessive use of plate cleaner when the plate is on the press may also cause the image to go blind. Rubbing the plate with ink may help in some cases, however, if the image starts to wear off of an offset plate, it may be impossible to restore it.

If the plate is to be saved after the run, you should allow the press to continue to rotate until the image is thoroughly inked. Then remove the plate, gum it, and allow it to dry. Paper separator sheets should be placed between the plates, and the plates should be stored in a cool, dry place, away from light.

PLATE NOT INKED UNIFORMLY

Since uneven inking may be caused by the setting of the fountain keys, most press operators make a preliminary setting of the fountain before they start the press. You should set the ink fountain blade to a uniform gap of 0.015 of an inch (one-half turn of the thumbscrews) for the average job. Turn the fountain roller by hand and adjust the keys until the roller is carrying an even film of ink. You can then put a few waste sheets through the press and make the final adjustments while the press is running.

If the printing image consists of heavy solids or large halftone areas, you should set the fountain roller for the maximum throw and adjust the ductor to dwell against the fountain roller as long as possible. Then open the keys on the fountain to provide the necessary ink.

If the image to be printed consists of small areas of type combined with large solids or halftone areas, you should open the keys more in the solid area but don't close the keys completely in areas where there is little or no printing. This will subject the keys to extra wear and may even spring the fountain blade.

On short, single-color runs, press operators sometimes add ink to the ductor roller with a knife or small brayer to increase the feed in the solid areas. All press operators do not agree with this practice, but there are times when it works effectively.

A true setting of the fountain is almost impossible until after the press has been running a while. For this reason, many press operators recommend putting 200 or more waste sheets through the press at the beginning of the run. They even run them through a second time, if necessary, while they adjust the keys on the fountain. This allows the ink and water to "run true" and helps to ensure accurate and uniform inking when the actual pressrun begins.

You have already seen that you should use less roller and printing pressure when you are running presensitized plates. Because these plates are almost grainless, they print a smoother, denser image with less ink and water than is required for conventional grained offset plates. The setting of the form roller pressure is more critical when these plates are used.

The form rollers on most presses are friction driven (by contact with other inking rollers). It is normal for these form rollers to drop slightly as they enter the plate cylinder gap, but they may lose contact with the drive rollers if they drop too low at this point. Too much of a drop will cause poor ink distribution and will also cause roller bounce when the rollers contact the plate again. This will result in roller streaks and skidding and cause wear on the offset plate. If the form rollers turn freely when they are in the cylinder gap, they are losing contact with the rollers which drive them. To correct this, you should reset the rollers with the proper tension.

TACKY INK

As a rule, you should run the ink as stiff and full bodied as possible. However, if the ink contains too much drier or too much heavy varnish, it may be so stiff and tacky that the rollers will not pick it up, or the rollers may be unable to distribute it evenly.

Stiff, tacky ink not only causes uneven inking, it may also cause particles of the paper, particularly coated stocks, to pick. You can add a little thin varnish to the ink or use less drier to remedy this situation. Picking may also be caused by a tacky blanket and/or too much water.

INK BACKS AWAY FROM THE FOUNTAIN ROLLER

If the ink does not flow freely or if it is not completely water repellent, it may become soft and puttylike and back away from the fountain roller. Since the fountain roller will not carry an even film of ink under these conditions, the resulting prints will be streaked and have a gray, grainy appearance. When you see the ink backing away from the fountain roller, you should stir it occasionally to give it a new contact with the roller. Running a thinner film of ink on the fountain roller and setting the roller for a longer throw will also help agitate the ink. If these remedies do not work, add a free-flowing varnish or replace the ink.

PILING

Sometimes the ink collects on the plate, blanket, or rollers instead of transferring to the paper as it should. This is known as "piling." When this condition exists, the prints will be gray and spotty even though the rollers seem to be carrying plenty of ink.

If the piling is due to excess drier or to buttery ink, you may be able to correct it by reducing the ink feed and using a thin varnish to make the ink flow more freely. Sometimes piling is due to the ink pigment being too heavy for the vehicle. In this case, you can improve the ink by adding a heavier varnish. Piling may also occur if the ink absorbs too much water or if excessive drier is used. Piling sometimes occurs because there is not enough pressure between the blanket and plate or the blanket and impression cylinders.

INK EMULSIFICATION

If the image covers 50 to 75 percent of the surface of the offset plate, it will use most of the ink fed to the rollers. But if the image area is small, some of the ink will remain on the rollers. This ink will pick up moisture from the nonprinting areas of the plate. These tiny drops of water will be dispersed or emulsified within the ink. This will cause the ink to lose its tack and shiny appearance and to become puttylike. As the pressrun continues, little beads of water may form between the ink rollers. The ink may become so waterlogged that it will start to pile on the rollers and plate.

Emulsification often occurs because the ink form rollers pick up gum or other chemicals when plates are changed or because the water fountain is not cleaned daily. As water evaporates from the fountain solution, the solution becomes gummy. The dampeners carry this gum to the plate and the ink form rollers pick it up. This gum eventually emulsifies within the ink, causing the ink to pile on the rollers instead of transferring to the plate. Sometimes a glossy film of moisture forms over the inking rollers. This moisture, which resembles glycerin in appearance, is more noticeable when the press is stopped. This contamination may go deep into the pores of the rubber press rollers and extensive roller cleaning may be necessary.

Papers and inks that are unsuited to the offset printing process sometimes cause emulsification. Too much fountain solution or a solution that has not been correctly mixed may also cause emulsification.

It may be necessary to use additional water if the plate was not desensitized properly, tends to scum, or if the dampeners are not set correctly. Sometimes a change in temperature or relative humidity after the pressrun commences reduces the rate of water evaporation to such an extent that it is necessary to change your water fountain feed to prevent emulsification.

When emulsification occurs, it may create other problems. For example, it may cause metal rollers to strip (refuse to take ink). It may also cause slow drying and dull, lusterless impressions.

When you are running small forms, you may be able to prevent waterlogging of the ink by occasionally shutting off the ink fountain. This allows the excess ink to work off the rollers. If the ink has a tendency to pile, you may be able to help the situation by adding a little thin varnish directly to the rollers at regular intervals. However, it is usually better to carry a small quantity of ink in the fountain and add fresh ink to it frequently.

When ink is too short or too soft, it is easily broken up or emulsified by the gum and acid in the fountain solution. You can correct this by altering the fountain solution or by adding a small amount of varnish to the ink.

BLEEDING

Sometimes so much water accumulates on the plate that the emulsification process is reversed and tiny particles of the ink are dispersed within the water. This is known as "bleeding."

If the ink is too short or if it is not water-fast, it may spread a light scum of color over the entire plate and printed sheet. Although it is possible to remove this scum with a wet sponge, it will reappear after a few impressions. You may be able to correct this situation by adding a nonbleeding varnish or tallow compound to the ink. If this doesn't help, you should switch to another type of ink. Occasionally bleeding occurs when the ink is too fresh and needs aging.

WATER-TO-INK ROLLER DAMPENING SYSTEMS

The dampener units used on some smaller presses vary from the conventional press dampening system. In smaller systems, the water and ink are both fed to the plate from the same set of form rollers. When the press is in operation, ink is distributed over all rollers, including those in the dampening system. The water fountain solution, in turn, is distributed to the rollers in the dampening system and to some of the ink rollers. Thus the form rollers are covered with a film of water as well as a layer of ink. As the plate travels against these rollers, the rollers give up their moisture to the nonprinting areas of the plate and transfer the ink to the ink-receptive image areas.

Water-to-ink roller dampening systems use less water than conventional dampening systems. Since this water is carried on the surface of the ink, most of it transfers to the plate before it has time to penetrate the ink. The ink absorbs a small portion of the water, but experience has shown that a small amount of water carried in the ink (20 percent or less) does not cause inking problems. Of course, emulsification problems may occur on these presses if too much water is used over a long period of time.

ROLLER STRIPPING

If the pressrun is long and you use too much water or too little ink, the excess fountain solution may work its way up between the ink rollers and etch the metal rollers to make them repel rather than accept the ink. This refusal of the rollers to take ink is known as "stripping." Stripping may also be due to too much phosphoric acid or gum in the fountain solution, dirty or incorrectly set rollers, and ink that is too short and buttery. It is often most pronounced on the ends of the metal rollers, but it may also occur at other points. These etched spots take ink when the press is not on impression, but they strip as soon as the actual printing begins.

When rollers begin to strip, you must counteretch them to make them sensitive to grease again. You can use a solution made with 1 ounce of 28 percent acetic acid to 3 ounces of water, or 3 ounces of nitric acid to 1 gallon of water for this purpose, or you can use a commercial plate counteretching solution. This solution should be used in the following way. First, wash the rollers thoroughly with roller wash or other suitable solvent. Then cover the plate and dampeners to protect them from the cleaning materials and go over the rollers again with water and pumice powder. After this you can apply the acid solution with a piece of cotton. Wear rubber gloves to protect your fingers. Allow the rollers to stand for several minutes, then scrub them with roller wash and pumice. Finish cleaning them with roller wash alone and then dry the rollers with a rag.

If the stripping is caused by too much water, reduce your water feed before you start the press again. Take a pH reading of the fountain solution to see if the acid is overactive. Although it may be necessary to vary the ingredients of the fountain solution for certain types of paper and ink or for changes in the weather, you should use only enough gum and acid to prevent the plate from scumming.

When the cause of stripping can be traced to the quality of the ink, change the ink or try one of the following remedies:

1. Use less drier.
2. Add free-flowing varnish.
3. Carry more ink on the rollers.
4. Keep only a small amount of ink in the fountain and add fresh ink to it at short intervals.

Some lithographic shops send their metal ink rollers to a commercial firm for copperplating or coating with hard rubber to prevent stripping. Chemical copperplating solutions are also available from printer's supply houses which you can apply to the metal rollers yourself without removing the rollers from the press. A chemical coating such as this is not permanent. It may last for several months however, and it is relatively easy to reapply. Some press operators coat the metal rollers with iodine to prevent stripping.

Teflon covers are used on the ink rollers of some presses to eliminate stripping, glazing, hickies, and other troubles.

GLAZE

If the rollers are not cleaned thoroughly during washup operations, the ink and gum will eventually fill the pores, and the rollers will become glazed. Glazed rollers have a hard, shiny appearance. Glaze is not a serious problem, but it may result in poor ink distribution and stripping. It may also cause the rollers to slip or skid and leave streaks and scum on the plate.

Glaze is less likely to develop when the rollers are hand washed, rather than using a washup attachment, especially if the roller setting is incorrect. When a washup attachment is used, improperly set rollers tend to clean unevenly. The ends of the rollers always present a special problem. If they are not thoroughly cleaned, the ink will dry and leave them in a glazed condition. Dried ink and gum may also flake off the ends of the rollers during the run and produce dirty or mottled impressions.

You can usually remove glaze by washing the rollers with fine pumice powder and roller wash, followed by a bath in lye water. You can prepare a lye bath by dissolving 6 tablespoons of lye in 32 ounces of water. Since lye is caustic and can cause skin burns, you should wear rubber gloves and work carefully to prevent skin contact. Apply the solution two or three times and rub the rollers with fine steel wool until the glaze disappears. When done properly, the rollers acquire a velvety appearance. Then wash the rollers with water and go over them with roller wash.

Commercial compounds and solvents are available for removing ink and gum glaze from the rollers. If you use these solvents, you should first wash the press in the normal manner with a roller wash and perhaps a washup attachment. Then apply the cleaning compound to the washed rollers while the press is rotating. Disengage the washup attachment if it is used, and allow the compound to work into the rollers for a few minutes while the press rotates rapidly. Then remove the compound from the rollers with the washup attachment and/or more roller wash (solvent). Use enough solvent when washing off the compound to flush the rollers and clean them thoroughly.

In extreme cases where the buildup of gum and/or ink glaze cannot be removed by the methods described here, the rollers have to be reground.

DIRTY OR IMPROPERLY SET DAMPENERS

Dirty or improperly set dampeners also cause uneven inking. Dampeners having two cloth coverings generally provide for better water distribution than those having only one. This is because the inner covering absorbs excess water which it gives up as necessary to supplement the intermittent (and short) supply of water fed to the

PAPER COVERINGS (INK)

In some shops, paper coverings are used on the form rollers. Paper covers tend to stay cleaner longer, and they provide more uniform contact with the plate. In fact, you may find that one paper cover does a better job than two cloth-covered rollers. However, paper covers are not interchangeable with cloth covers. To switch to paper covers, you must cover the roller cores with a softer rubber that is ground to precision dimensions.

Changing paper covers is a simple procedure and takes about 5 minutes. After a dampener is properly recovered, it seldom requires a resetting to the plate because the roller's surface is as true and even as it was before recovering. If resetting is necessary, adjustments are minor.

BLANKET TROUBLES

If the image inks up on the plate but fails to transfer or does not print evenly on the blanket, the trouble is generally due to insufficient packing under the blanket or plate. It may also be due to a damaged or defective plate or blanket.

IMPROPER CONTACT BETWEEN BLANKET AND PLATE

Press operators generally use 0.003 to 0.004 of an inch squeeze (pressure) between the plate and blanket when they are running grained offset plates. They use 0.002 of an inch squeeze when they are running presensitized or grainless plates. Too much pressure or squeeze will result in excessive wear on the plate, and too little pressure will result in a light, spotty image.

If the image does not transfer from the plate properly, you should first check the packing behind your plate and blanket. Since the blanket stretches, its thickness may change 0.001 of an inch or more after it is drawn taut around the cylinder, and extra packing may be required to bring it back to the proper height. If the first few impressions look light and spotty after you have put on a new blanket, the blanket may need more packing under it.

When the blanket is drawn around the cylinder, it always stretches thinner in the center than it does along the edges. This makes it difficult to attain accurate readings using a micrometer.

check the thickness of the plate and blanket packing without removing them from the press.

It is a good idea to use hard paper for packing sheets. If you use soft, bulky paper, it will beat down as the run progresses and may cause spotty, uneven impressions.

The thickness of the blanket may change with the temperature of the pressroom. In fact, the blanket and packing may shrink overnight in hot, dry weather. When this happens, you may be able to get enough moisture back into the blanket to swell it to its original thickness if you wash the surface with solvent and wet it down a few times with water applied with a sponge. If this doesn't help, it will be necessary to add more packing. Many press operators release tension or loosen the blanket if the press is to sit idle.

Sometimes you will get an uneven image on the blanket because the cylinder bearers are not contacting properly. If the bearers do not touch when the impression is on, you should adjust your blanket-to-plate tension. If the bearers contact on one side but not on the other, you should parallel the two cylinders.

You can check bearer contact by putting an inked fingerprint on the surface of one bearer. If the fingerprint transfers an image to the other bearer as the press in turned over or jogged with the impression on, the bearers are contacting properly.

Most small offset presses or duplicators do not have bearers. Remembering that most presses are designed to have normal printing pressure or squeeze between their cylinders without the use of packing under the plate or the blanket, you can check the cylinder alignment and the pressure between cylinders on these presses in the following manner:

1. Remove the plate and blanket and wipe both cylinders clean.
2. With the impression on, rotate the press slowly by hand while feeding in a length of liquid-core solder between the plate and the blanket cylinders. The diameter of the solder should be about one-eighth of an inch, and it should be flattened somewhat by the pressure as it is fed between the cylinders.
3. Back the solder out by turning the flywheel in the opposite direction. Then measure the flattened portion with a micrometer. If the "mike" reading corresponds to the combined thickness of the plate and blanket, minus one or two thousandths for adequate printing pressure, the distance between these cylinders is correct. If solder is inserted at both ends of the plate and the blanket cylinders and the same "mike" reading is obtained by measuring the flattened solder, the cylinders are parallel to one another.

LOW SPOTS IN BLANKET OR PLATE

Spotty printing on the press sheets is usually caused by low spots on the surface of the blanket, low spots on the plate, or dents or low spots on the press cylinders. Low spots in the plate may be due to defects when it was produced, but they are more commonly due to bruises caused by wrinkled or folded sheets running through the press (press sheets). These wrinkled sheets may cause low spots in the blanket because of the pressure they create between the blanket and the impression cylinders. If you will put additional packing under the blanket in these areas, this packing should raise them to the proper height. There are also commercial chemicals available that, when applied to low spots in the blankets, cause the blanket to swell only in that area.

APPENDIX VI

GLOSSARY

ABERRATION.—Lens defect which causes a fuzzy or distorted optical image.

ABRASIVE.—A hard material used for cutting into softer materials, as in graining lithographic plates.

ABSORPTION.—The taking of one into another, as ink into paper to facilitate drying; or as in light rays, a filter passing its own color and holding or absorbing others.

ACCELERATOR.—A substance (usually an alkali) used in developer to speed up the chemical action of the developing agents on the emulsion of exposed film.

ACCORDION FOLD.—A term used in binding to describe two or more parallel folds which open like an accordion.

ACETATE SHEETS.—Sheets of thin flexible, transparent material used as a base for photographic film and as a support for deep-etch layouts.

ACETIC ACID.—An acid used as a counteretch in plate making and as a short stop bath in negative processing.

ACHROMATIC LENS.—Lens which refracts light rays of all colors equally for focus on a single plane; a lens which is free from chromatic aberration.

ACID.—A compound containing hydrogen which can be replaced by certain metals to form salts. Acids are sour to the taste; they turn blue litmus paper red.

ACTINIC.—A property of light rays which produces chemical changes in photographic emulsions.

ACTINIC LIGHT.—Rays of light, especially the shorter waves of the spectrum, such as green, blue, and ultraviolet, which causes chemical changes in light-sensitive photographic emulsions.

ACTIVATOR.—A name given to various developers used in Ektalith processors, automated camera-processor plate making machines, and so on.

ADDITIVE PROCESS.—A process by which white light can be produced by combining colored lights until white is obtained.

ADHESION.—An important requirement of inks to be used on nonabsorbent stocks, such as plastics or metal foils.

ADJUSTABLE BED TRACKS.—On automatic platen presses, adjustable tracks for the ink rollers.

ADLUX FILM.—A trade name for slow-speed continuous-tone emulsion on frosted acetate; used for making transparencies and for photographically converting screened copy to continuous tone.

AFFINITY.—The inherent attraction of one substance for another; the tendency of two substances to adhere to one another; or the tendency of one substance to absorb another.

AGATE.—A unit of measure; approximately 5 1/2 points.

AIR BELLS.—Small bubbles of air that sometimes form and cling to the emulsion during film processing.

AIR BRUSH.—A miniature paint sprayer; used by illustrators to prepare or retouch continuous-tone copy.

AIR CONTROL LEVER.—On C&P automatic presses, a lever for opening and closing the feeder suction line.

AIR ERASER.—A miniature sandblasting apparatus; sometimes used by artists and lithographers for touch-up erasing on artwork or grained plates.

AIR SUCTION INLET.—On some ATF presses, an opening in the feeder suction line which must be closed to start sheets feeding.

ALCOHOL.—A volatile liquid solvent. Anhydrous alcohol is water free.

ALIGN (ALINE).—To position type and cuts in a straight line.

ALKALI.—A soluble base compound which neutralizes acids to form salts. Alkalies have a biting taste and are slippery to the touch; they turn red litmus paper blue.

ALPHA CELLULOSE.—A material used in making papers which require a strong, yet soft and flexible texture.

ALUM (POTASSIUM ALUM; ALUMINUM POTASSIUM SULFATE).—Salt used to toughen colloid films in photography and as an ingredient in preparing lithographic plates for tusching.

ALBUMIN.—A protein substance obtained from organic sources, especially egg whites; used in the albumin plate making process as the base ingredient of the plate coating.

ALUMINA HYDRATE.—An ink extender of very low specific gravity and almost transparent.

ALUMINUM OXIDE.—A hard crystalline material used as an abrasive for graining plates.

AMMONIA PROCESS.—The development of a diazo image by the used of heated ammonia fumes, such as the ozalid process.

AMMONIUM BICHROMATE.—Red crystals which become light sensitive when mixed with an organic solution, such as albumin; used in plate making and photographic reversal processes.

AMMONIUM DICHROMATE.—Same ammonium bichromate.

AMMONIUM HYDROXIDE.—Ammonia gas dissolved in water; used to alkalize the light-sensitive coating in plate making and in diazo development.

ANGSTROM UNIT.—A unit of measure; used to measure the length of light waves; equal to one ten-billionth of a meter (about 254,000,000 units per inch).

ANHYDROUS.—Water free or without water, as anhydrous alcohol.

ANILINE PRINTING.—Printing done with rubber plates and aniline dyes; also called "flexography."

ANIMAL BLACKS.—An ink pigment made by charring animal bones from which the oily and fatty matter has been extracted.

ANTIHALATION BACKING.—A coating of dye which prevents internal reflections from the acetate base of the film back to the emulsion.

ANTIQUE FINISH PAPER.—A natural, rough surface on book and cover papers; may be woven (simulating cloth) or laid (ladderlike) in appearance.

APERTURE.—The lens diaphragm opening; the opening through which the light enters the camera. Not to be confused with the shutter.

APOCHROMATIC LENS.—Lens corrected to eliminate chromatic and spherical aberration.

AQUAMATIC UNIT.—A trade name for water-to-ink dampening system on A. B. Dick presses.

ARC LAMP.—A light source in which an electric arc is formed between two carbon electrodes when current is applied.

ART TYPE.—A trade name for waxed sheets of acetate printed with characters (type), dot patterns, or textures which may be cut out and mounted on reproduction copy.

ASPHALTUM.—A nondrying, bituminous substance used as a base or protective coating for the image on a lithographic plate.

through the edge of the lens do not focus at the same point (behind the lens) as rays which pass through the center. Using a small aperture will sometimes remedy this defect.

AUTHOR'S ALTERATIONS (AA's).—Changes made by the originator after the material has been typeset.

AUTOMATED CAMERAS.—Cameras which load the film, make the exposure, and develop the film automatically.

AUTOMATIC FOUNTAIN TRIP.—On offset presses, a device which stops the ink feed when the impression is off.

AUTOMATIC PRESSURE.—See compensating pressure.

AUTOMATIC THROW-OFF.—On automatic platen presses, a device which trips off the impression when a sheet fails to feed.

AUTOMATIC TRIP.—On offset presses, a device which trips off the impression and ink when a sheet fails to feed.

AUTOPOSITIVE.—An emulsion which produces a positive image from positive copy. A yellow filter is generally used in making the exposure.

AUTOSCREEN ORTHO FILM.—A film used in producing halftone negatives from continuous-tone copy without the use of the halftone screen. The screen pattern is formed in film emulsion during manufacture.

AVERAGE GRADIENT.—Contrast index determined by measuring the slope of a straight line drawn between the two points on the characteristic curve (D log E) which represent the maximum and minimum densities normally used in making negatives or positives.

BACK CYLINDER.—The impression cylinder of an offset press.

BACK MATTER.—The back pages of a book, such as the appendix, glossary, bibliography, and index.

BACKBONE.—The bound edge of a book; also called the "spine."

BACKGROUND.—The non-image area of a print; also called "discoloration" or "scum" in that area. Photographically, the area surrounding the central object in a photograph.

BACKING AWAY.—A term used to describe the condition where the ink does not follow the fountain roller.

BACK-ETCHING.—Reducing the density of film positives or negatives with Farmer's Reducer.

BACK GAUGE.—On paper cutters, a fingered metal bar against which the paper is squared.

BACKLASH GEAR.—See split gear.

BACKLIGHT.—In process camera work, to illuminate the copy from behind.

BACKUP.—To print the reverse side of a sheet that has printing on the front.

BARREL.—A cylinder in which lens elements are mounted.

BASE.—A support, such as glass or acetate for photographic emulsion; also a block or plate on which electrotypes are mounted for lockup. See alkali.

BASE COLOR.—First down or background color printed on the press.

BASTARD SIZE.—Not of standard dimensions.

BATTER.—A bruised or low area in the surface of a blanket.

BAUME.—A unit of measure used in measuring the density of liquids.

BAUM FOLDER.—A trade name for a roller-operated folding machine.

BEAM.—A ray or shaft of light.

press cylinders that roll in contact with one another, maintaining correct separation between cylinders.

BED.—A flat part of a letterpress on which the typeform rests.

BELLOWS.—A flexible, lighttight enclosure connecting the lensboard and the camera back.

BELLOWS EXTENSION.—See camera extension.

BENDAY.—A term applied to tint effects, such as lines, dots, or patterns applied to art, negatives, or plates.

BEND OF THE PLATE.—A place where the plate is bent along the leading and trailing edges when it is wrapped around the cylinder of an offset press.

BIJUR CENTRAL LUBRICATOR.—A trade name for a system of feeding oil to the main bearings of some offset presses.

BIMETAL PLATE.—An offset press plate consisting of two layers of metal. During processing, the top layer is etched away in the image areas to expose the bottom layer which is especially sensitive to grease.

BIND.—To join pages of a book together with thread, wire, adhesive, or other means; also to enclose the pages in a cover.

BITE.—(1) The amount of space by which the press grippers overlap the leading edge of a sheet; (2) the action of etch on metal, as in photoengraving; (3) the affinity of paper for ink.

BLACK PRINTER NEGATIVE.—In color-separation work, a negative made with a yellow filter or a combination of filters. The plate made from this negative is run on the press in black ink.

BLANKBOOK WORK.—The production of ledger books, notebooks, etc., which contain blank or ruled pages for notes or accounting purposes.

BLANKET.—A sheet of vulcanized rubber bonded to fabric backing which forms the covering of the press cylinder that transfers ink from the plate to the paper.

of French chalk and powdered sulfur used to relieve the tackiness of a blanket.

BLANKS (PAPER).—Paper boards ranging in thickness from 0.012 to 0.078 of an inch.

BLEED.—(1) To cut off (as prescribed by the page layout) one or more edges of an illustration, solids, or any appropriate image area in trimming the printed matter to final size; (2) the name given to that portion which is to be cut from the illustration in trimming the printed page to final size; (3) to position illustrations, solids, etc., so that one or more of their edges are cropped when the page is trimmed to final size; (4) a term used to describe a condition wherein ink pigment is being dissolved by press fountain solution, causing tinting.

BLIND.—A term used to describe the condition when the image area of the plate will not accept ink.

BLOCK OUT.—To mask or paint over with opaque the transparent portions of a negative that should not image the plate. Opaquing is sometimes referred to as "blacking out."

BLOOM.—A coating which forms on rubber blankets in storage. It should be washed off before use.

BLOWER.—A mechanism which supplies a blanket of air to separate the top sheets from others in the paper stack of the press or folder.

BLOW UP.—To enlarge photographically.

BLUELINE.—A photographically prepared image consisting of blue lines on acetate, metal plates, or paper; used for pasteup or registration layout work; sometimes called "blue key."

BLUE KEY.—A blueprint on glass or vinyl plastic of a design containing all elements with register marks; used as a guide for stripping a flat of photographic elements of other colors so that the colors will register.

BODY (INK).—A term referring to the "consistency" of the ink.

BODY GUM.—A thick varnish used to stiffen inks.

BODY TYPE.—The type used in the text or body of a printed page. See display type.

BOND INK.—A short, stiff ink made for printing on bond paper.

BOND PAPER.—A hard-finished paper receptive to printing and writing inks; used for stationary, forms, etc.

BONE FOLDER.—An animal bone, shaped somewhat like a knife blade; used as a tool in folding by hand.

BOOK PAPER.—A paper suitable for printing books, catalogs, magazines, etc.; may be coated or uncoated, in a variety of finishes, and may or may not be sized for offset printing.

BORDER.—A ornamental or finishing rule used around the edge of printed matter.

BOX.—To enclose a paragraph or heading with borders or rules.

BRASS RULE.—A thin strip of rolled brass used for printing borders or lines in letterpress forms.

BRASS SPACE.—A thin space used in justifying lines of hand-set type.

BRAYER.—A hand roller used in inking types of forms for proofing; also called the "rollers" on some C&P presses.

BRISTOLS.—Lightweight cardboards, as index bristols, mill bristols, and wedding bristols.

BRISTOL BOARD.—A heavy, thick paper composed of layers of paper bonded together, such as cardboard or posterboard. The layers are called "plies," and the thickness of bristol board is described accordingly, as two-ply, three-ply, and so on.

BROAD.—In layout, placing the top of the image at right angles to the greater dimension of the page. Generally in publication work, the head is placed at the left side of the page on both right- and left-hand pages.

BROCHURE.—A pamphlet or booklet.

BROMIDE.—A compound of bromine and another element. Silver bromide is a light-sensitive salt used in photographic emulsions.

BRONZING.—Applying bronze metallic powder to the wet ink of freshly printed sheets with a bronzing machine or by manual dusting.

BROWNPRINT.—A photographic print or silver print which displays its tone or detail in brown; not to include a sepia print or a contact print that received a toning treatment.

BUCKLE CONTROL KNOB.—An adjustment on A. B. Dick presses for regulating the buckle of overfeed of the paper as it is fed into the cylinder grippers.

BUFFER.—A chemical agent used to control the activity of developer.

BUILT-IN WRENCH.—On some presses, a device for loosening the cylinder from the gear when raising or lowering the image on the paper.

BULK (OF PAPER).—An expression indicating the number of paper sheets per inch of a given paper weight.

BULLETS.—Dots used as ornaments in composition.

BUMP EXPOSURE.—In making halftones with a contact screen, a highlight exposure made with the contact screen removed from the camera.

BURN.—To print (expose) a photolithographic plate with bright light in a vacuum frame.

BURN OUT.—To overexpose when printing a plate with a positive so that sufficient exposure can be achieved through dirty or less than totally transparent areas of the positive.

BUSINESS PAPERS.—Papers used for administrative uses, such as bonds, punch cards, safety papers, mimeograph, and duplicator papers.

CAKING.—A buildup of ink pigment on rollers, plates, or blankets, caused by failure of the vehicle to hold the pigment in suspension.

CALCIUM CHLORIDE.—A crystalline compound used in developing deep-etch plates.

CALENDER.—A bank of rollers at the end of a papermaking machine through which the web of paper is passed to impart a smooth finish.

CALIFORNIA JOB CASE.—A typecase having compartments for lowercase letters, capital letters, figures, punctuations, ligatures, quads, and spaces. The size and arrangement of lowercase compartments afford more storage space for frequently used characters and ease of access to them. Compartments for capital letters are of equal size, in alphabetical sequence, except for J and U which are placed at the end of the alphabet.

CALIPER.—A device that prevents more than one sheet from being fed into the press at a time; sometimes called a "multiple-sheet choke."

CALIPER (OF PAPER).—A term denoting the thickness of paper, expressed in thousandths of an inch. Each thousandth is called a "point" or, less commonly though preferably, a "mil."

CALLIGRAPHY.—A form of hand lettering frequently used on book jackets, title pages, cards, and letterheads. The calligraphic letter is based on the handwritten cursive alphabet of the 16th century.

CAM.—An eccentric disk or wheel.

CAMERA EXTENSION.—The distance between the lens and focal plane when the camera is in focus at any given percentage.

CAMERA-PROCESSOR.—An automated process camera and a plate maker combined into one machine.

CAMERA-READY.—A copy that is complete and ready to be photographed.

CANDLEPOWER.—A unit of measure of a light source.

CAPTION.—Words entitling, defining, or explaining an illustration in one or more lines above the illustration. The term is often used loosely to refer to "descriptive matter appearing below a picture."

CARBONS.—Compressed carbon rods of varying thickness and length; used to produce arc illumination in camera and plate making equipment.

CARBON BLACKS (INK).—Ink pigments consisting mainly of the element carbon made by partial combustion of natural gas.

CARBON TETRACHLORIDE.—A colorless nonflammable fluid used as a solvent. It is dangerous when used without adequate ventilation, and its use is prohibited aboard naval vessels.

CARTOGRAPHY.—The art of making maps or charts.

CASEIN.—A protein extracted from cows' milk; sometimes used in plate making instead of albumin to make up the light-sensitive coating. It is the main ingredient of many adhesives and the binder of clay coating (sizing) on coated paper.

CASING IN.—In bookbinding, a process of attaching the cover to the book.

CASEIN PROCESS.—A plate making process similar to that used in making albumin plates.

CASTING COPY.—To calculate the space manuscript copy will occupy when set in type.

CATCHLIGHTS.—The negligible highlight areas, as in the whites of the eyes.

CATCH-UP.—A localized tinting caused by inadequate or improper dampening of the plate on the offset press.

CATCHER PAN.—On small offset presses, a pan below the conveyor tapes which receives sheets deflected by the caliper.

CATCHING-UP.—Gradual accumulation of ink in non-image areas of the plate during press operation.

CAT'S WHISKERS.—Short pieces of wire or thin strips of metal used on feeders of some presses as separator fingers.

old images from press plates.

CELLOPHANE PRESS.—A proof press designed to print on acetate.

CELLULOSE GUM.—A water-soluble substance; useful as a substitute gum. It is made from wood fiber cellulose.

CENTER LINE.—A short line applied to the copy, a negative, or a flat; used to indicate the center of the trim margins of a form or all the forms on a press sheet; also used for registration.

CHAIN DELIVERY.—A mechanism on some presses consisting of two endless chains with grippers mounted on bars which are stretched between them; used to transport the sheet from the impression cylinder to the delivery pile.

CHALKING.—A powderlike condition of dried ink pigment on a paper surface when too much of the binding vehicle is absorbed by the paper. The dried ink tends to rub off or smudge the sheet when touched.

CHAPTER SINK.—A blank space above the chapter heading in a book.

CHARACTER COUNT.—The estimated number of characters, including spaces between words, in manuscript copy which provides the means of determining how much space the text will occupy when converted from typewriter characters to type.

CHARACTERISTIC CURVE.—A curve denoting the response of a specific film emulsion to exposures of various durations and development of various durations.

CHARACTER RECOGNITION.—Information in machine-readable form for automatic data processing; may consist of punched cards or tapes or markings with a pencil in a predetermined spot so that it can be sensed with a photocell. Machines have recently been developed that can read numbers, such as those produced on bank checks with magnetic inks. Machines can also read typefaces and typewritten material, and some can even read handwriting.

developer.

CHEMICAL GRAINING.—In the manufacture of lithographic plates, producing a grained surface on metal plates by means of chemicals.

CHICAGO SCREWS.—A trade name for metal screw posts used in bindery work in which a larger female threaded post is inserted through the binding hole and capped with a smaller, male threaded screw.

CHINESE WHITE.—Artist's white watercolor used in retouching.

CHIPBOARD.—A rough surfaced cardboard used as backing for pads and tablets.

CHOKE.—Same as caliper or two-sheet choke.

CHROMA.—The composition of a color, defining its hue, and the amount of black or white it contains. White, gray, and black are neutrals, not colors, and have no chroma. The term is often used loosely to mean the "brilliancy" or "purity" of a color.

CHROMATIC ABERRATION.—The failure of a lens to focus all the colors on the same plane, causing a colored outline or blur.

CHROMIC DERMATITIS.—Skin disease; injury to human tissues caused by chromic acid and salts of chromium.

CIRCLE FOLIO.—A number (with a circle around it) penciled on a page layout, usually at the lower right-hand corner to identify the page as to its position in the publication. It does not appear on the final product but serves as a guide for page imposition when some pages of the job are to be printed without page numbers, such as the preface or other front matter pages.

CIRCULAR SCREEN.—A glass halftone screen, circular-shaped to allow for rotation to various screen angles in color work.

CITRIC ACID.—A mild acid used for developing and cleaning deep-etch plates.

CLEARING.—(1) The action of hypo in rendering unexposed film transparent or image detail of negative transparent; (2) bathing unexposed film in hypo to obtain clear sheets of acetate; (3) removing fog from negatives or positives with reducer, etching needle, or any other means.

COAT TAR DYES.—Artificial organic dyes; used extensively in the manufacture of printing ink because of their superior brilliancy in comparison to other types of dye.

COATED BLANKS.—Cardboards of two or more plies coated on one or both sides; used for signs, posters, tickets, etc.

COATED PAPER.—Any paper to which a surface coating has been applied.

COATING.—(1) To apply light-sensitive material to the surface of a plate; (2) the light-sensitive material.

COBALT DRIER.—A liquid drier resembling dark varnish; primarily a surface-type drier for use with dark offset inks; a fast drier used for single-color printing; provides a hard surface which resists rub.

COLD COLOR.—A color with a bluish or greenish cast to it; cold black has a bluish tint as opposed to a warm black with a reddish tint.

COLD SHOT.—Shooting a screened original without using a halftone screen; also called a "screened pickup."

COLD-TYPE COMPOSITION.—Composition produced by any means other than that used for letterpress. Typewriters are considered cold-type composing machines.

COLLOTYPE PRINTING.—Also known as "photogelatin printing." A printing process which uses plate images comprised of bichromated gelatin. Such images provide for the printing of continuous tone because the gelatin has different degrees of ink and water receptivity. This process is limited to short runs.

COLLATING.—Gathering single sheets or leaves in sequence.

COLLOID.—Organic substance, such as albumin, starch, or gelatin, apparently dissolved, but in suspension in a liquid.

COLOR CORRECTION.—Any technique which alters the density in specific areas of a negative or positive and thus provides for more accurate color rendition, as dot etching or masking.

COLOR-BLIND EMULSION.—Photographic emulsion sensitive only to blue and violet.

COLOR KEY.—Thin, light-sensitive color-coated acetate sheets for use in proofing multicolor jobs; colored coatings on these sheets match standard process colors. The sheets are exposed through separation negatives and developed with a chemical which dissolves the unexposed coating, leaving a colored image.

COLOR PATCH.—Sometimes called "color swatch." A sample usually attached to the original to show the precise color of ink required in printing the job.

COLOR SEPARATION.—The process of photographing each primary color of a full-color original on a separate sheet of film; also the preparation of artwork for multicolor reproduction, whereby an overlay is made for each color involved.

COLOR TRANSPARENCY.—Transparent, full-color photograph; a color slide which is shown in a slide projector.

COLUMN INCH.—A space one inch deep and one column wide.

COMA.—A comet-shaped distortion produced by the curvature of the lens.

COMBERS.—On some offset presses, wheels which buckle the top sheet in the feed pile to start the sheet separation.

COMBINATION ART.—Artwork containing both line and tone work.

COMBINATION LAYOUT.—Line and halftone negatives or positives stripped onto the same flat; also a flat containing a number of unrelated jobs.

COMBINATION PLATE.—An offset plate imaged with both halftone and line work; also a plate on which there are two or more unrelated forms for simultaneous printing.

COMPENSATING PRESSURE.—A feature on some duplicators which allows the printing pressure to automatically adjust to varying paper thicknesses.

COMPLEMENTARY COLORS.—Red and green; blue and orange; yellow and purple. When any two of three primary pigment colors are mixed to form a secondary color, the remaining primary is complementary to the mixture. Any two colors of light that produce a neutral gray or white when combined are said to be "complementary."

COMPOSITOR.—A person who sets letterpress type or prepares cold-type composition.

COMPREHENSIVE.—A detailed layout with illustrations carefully drawn and type positioned; often called a "comp."

COMPUTERIZED COMPOSITION.—Typeset composition produced with the aid of computer tapes which drive the typesetting machines.

CONCAVE LENS.—A lens with edges thicker than the center.

CONJUGATE DISTANCE.—The distances of object and image from the lens are called "conjugate distances." For every position that an object may occupy with respect to a lens, there is a corresponding position for the image.

CONSTANT PRESSURE.—On the folder, rollers set to operate in rolling contact with each other. See suspended pressure.

CONTACT.—Photographic print on film or paper, produced by contact exposure to a film positive or negative in a contact printer or similar equipment.

CONTACT NEGATIVE.—Same-size duplicate made by exposing a sheet of film to a film positive.

CONTACT POSITIVE.—Same-size duplicate made by exposing a sheet of film to a film negative.

CONTACT SCREEN.—A halftone screen made on safety base film; used in absolute contact with the film emulsion.

CONTINUOUS FEEDER.—A type of feeder on some presses and folders which allows stock to be loaded without interrupting operation of the machine.

CONTINUOUS TONE.—Image consisting of blacks and intermediate shades of gray; not produced by a pattern of varying size dots.

CONTRAST.—Tonal range of photographs, negatives, artwork, etc. The degree of difference between the darkest shadows and the brightest highlights.

CONTRASTY.—Having sharply defined light and dark tones and limited or no medium tones.

CONTROL SHEET.—A sheet used for checking progress of work.

CONTROLLED FLASH METHOD.—In camera work, the method whereby a halftone negative is produced with a two-step exposure—a detail and flash exposure.

CONVENTIONAL PLATE.—A term applied to albumin, deep-etch, or similar plates.

CONVEX LENS.—A lens whose center is thicker than its edges.

COVER PAPERS.—Paper which serves for covering printed material, made in a wide variety to provide a desirable choice.

CONVEYOR TABLE.—A feedboard on the offset press.

CONVEYOR TAPES.—Endless fabric belts which carry the paper down the feed table to the printing unit of the offset press.

COPY.—A term liberally used to mean anything submitted for graphic reproduction; as an original which can be more specifically defined as either "line copy" or "tone copy." In the strictest sense, only manuscript or text submitted to the printer is considered copy.

COPY FITTING.—Calculating the proper type size and line width to accommodate copy within a given space.

COPYHOLDER.—A person who aids the proofreader by holding the copy and reading aloud; also called the "copyboard" of a process camera.

COPY PLANE (COPYBOARD, SUBJECT HOLDER).—A flat surface on which the copy is positioned in alignment with the camera lens for photographing.

CORE.—In photography, the central portion of a halftone dot; on presses, the steel shaft on which rollers are formed; on paper, the wood or metal spindle on which paper is wound.

CORONA.—A high-voltage discharge; also the name given to the electrical assemblies in an electrostatic copying machine which provide the high-voltage discharge.

CORRUGATING BARS.—A name applied to the sheet-flattening bars on the Harris offset press.

COUNTERETCH.—Cleaning the press plate with a diluted acid solution to remove dirt and oxidation to make the plate surface more receptive to ink.

COVER INK.—A stiff, full-bodied ink with good covering capacity; used chiefly for letterpress printing of cover stocks.

COVER STOCK.—A paper used chiefly for booklet covers, tickets, etc.

C. P.—A abbreviation for chemically pure.

CRASH.—In bookbinding, a linen cloth used along the backbone of a book.

CRAFT-TINT.—A trade name for a chemically impregnated drawing paper whose pattern of lines and dots is brought out by brushing with chemicals.

CREEP.—Stretch, slippage, or any movement of the blanket that causes misregister during press operation. Generally occurs when the blanket is loosely mounted on its cylinder or when too much packing is used.

CREDIT LINE.—A courtesy line denoting the source of the material printed in a publication.

CROP MARKS.—The marks on an illustration to show which portion is to be reproduced.

CROPPING.—Trimming off or marking for deletion the unwanted portions of photos and drawings having excess background area around the subject.

CROSS CARRIERS.—On folders, revolving rollers which carry paper from one section to the next.

CROSSHATCH.—Crisscross lines in a line drawing that give the effect of tone or shading.

CROSSLINE SCREEN.—A glass halftone screen having opaque lines which cross at right angles, as distinguished from single-line screens that have lines in one direction only.

CRYSTALLIZATION (INK).—A term used to describe a condition which occurs when an ink dries so that succeeding colors will not adhere properly.

CRYSTALS.—Fixed forms caused by solidifying of an element or compound; though seemingly dry, they may contain moisture.

CUT.—A metal plate having an etched image for letterpress printing; also a term used to describe any illustration used in a printing job.

CUTLINES.—Legends and captions.

CUTTING BLADE.—A washerlike cutting attachment used on some presses and folders.

CUTTING STICK.—A hardwood or plastic insert in bed of paper cutter into which the knife passes after completing its stroke.

CYAN.—Blue-green color.

CYLINDER BRUSH.—On some offset presses, a wide brush which rides against the face of the impression cylinder to remove dust, lint, and wrinkles from the sheet as it proceeds through the printing unit.

CYLINDER GAP.—A recess or opening in a press cylinder.

CYLINDER UNDERCUT.—On plate and blanket cylinders, the difference in height between the bearer and cylinder body.

DAHLGREN DAMPENING SYSTEM.—A trade name for a water-to-ink dampening system, developed for use on the larger offset presses.

DAMPENERS.—Press rollers used for dampening the offset plate.

DARK REACTION.—A plate coating becoming hard or dried out on the plate before actual exposure takes place. An unwanted reaction common with albumin and casein coatings, which results when there is too much delay between operations of coating and printing the plate. Dry, warm air in the plate making area accelerates this action.

DARKROOM CAMERA.—A process camera with the back built into the darkroom wall.

DAY-GLO INKS.—Fluorescent inks.

DEAD.—Cancelled, finished; not to be used again, as a dead form.

DEEP ETCH.—Lithographic plate making process in which the image areas are slightly etched into the plate surface.

DEFLECTORS.—On folders, a plate placed over the mouth of the fold plate to prevent the sheets from entering.

DELIVERY ARM.—On automatic platen presses, a device which carries printed sheets from the platen to the delivery table.

DELIVERY GRIPPERS.—Metal fingers attached to a bar extended between two continuous chains which receive the sheet from the impression cylinder grippers and carry it to the delivery platform.

DELIVERY PLATFORM.—The platform on which the printed sheets are deposited at the delivery end of a press. A dolly (platform with wheels) is commonly used with a large press.

DELIVERY TABLE.—On platen presses, a table on which printed sheets are stacked as they are removed from the press.

DENSITOMETER.—An instrument for measuring the reflection and/or transmission density of opaque copy or negatives.

DENSITY.—The measure of opacity or ability of a film to stop light; also called the "thickness" of a solution.

DENSITY RANGE (OF HALFTONE SCREEN).—The range of tone which the screen can produce. Determined by subtracting the density reading of the shadow areas from the highlight density on the negative.

DERMATITIS.—A skin disease characterized by an itching rash, swelling or roughening of the skin, or water pustules. In lithography, caused by photographic developers, chromium compounds, and solvents. See chromic dermatitis.

DESENSITIZE.—Making non-image areas of the plate nonreceptive to ink by chemical treatment of the plate using gum solution or etches. See etch.

DESSICATED.—Completely dried; having all moisture removed.

DETAIL EXPOSURE.—Halftone exposure capturing all the minute detail of the copy.

DETECTOR.—A device on the offset press which kicks off the impression when a sheet fails to feed through properly.

DETECTOR FINGER.—A device on the offset press which kicks off the impression when a sheet fails to feed through properly.

DETENT PAWL.—A locking device causing the impression to remain on as long as paper is fed through the press.

DEVELOPMENT BY INSPECTION.—To visually inspect film at appropriate intervals during development.

DIAPHRAGM.—A device used to control the amount of light admitted through the lens to the camera.

DIAZO COMPOUND.—A light-sensitive aromatic nitrogen by-product of coal tar which is used as a coating on presensitized offset plates.

DIAZO PAPER.—A paper coated with a light-sensitive dye that can be decomposed or bleached by light. It is usually developed with ammonia.

DIFFUSED LIGHT.—Light waves thrown back or reflected in several different directions.

DIFFUSER.—Frosted glass or any translucent material that acts to spread light when placed directly in front of the source.

DIFFUSION TRANSFER PLATE.—Uncoated aluminum or plastic plates prepared by exposing a special sensitized material, developing it, then passing the material and plate through pressure rollers. The image is transferred to the plate by pressure and diffusion.

DINGBATS.—Stars or ornaments used in type composition.

DIRECT IMAGE.—Image applied directly to a metal or paper lithographic plate (of the so-called "master" variety) without using a photographic process. Image application is usually performed with a typewriter having a special ribbon or with reproducing pencils and pens.

DIRECT-IMAGE PLATES.—Plates which are imaged by typing, drawing, lettering, or imprinting directly on the plate.

DIRECT METHOD (IN COLOR-SEPARATION WORK).—A method which consists of making the halftone negative for each color directly from the original copy. See indirect method.

DISK.—A circular plate; part of the ink distribution system of platen presses.

DISPERSANT.—A petroleum liquid which acts as a carrier for the toner particles in the A. B. Dick Model 675 electrostatic copier.

DISPLAY TYPE.—Type larger than body type; used to draw attention.

DISTORTION.—Lens aberration in which straight lines appear curved.

DISTRIBUTE.—To return hand-set type to proper compartments in the case.

DISTRIBUTOR ROLLERS.—Inking rollers which break down the ink by sidewise as well as rotary movement.

DOLLY.—A platform on wheels, designed for use as the delivery platform of a press. When lowered to the floor and disengaged from the press, it serves as a cart for moving the printed matter to the bindery.

DOPING.—Changing ink characteristics by adding driers or other ingredients to ink.

DOT ETCHING.—Reducing the size of opaque dots in specific areas of a halftone negative or positive by applying a reducer locally to those areas with a cotton swab.

DOUBLE PRINTING.—Combining details of two negatives by successively exposing both on the press plate in register.

DOUBLE SPREAD.—Facing pages in a publication laid out in such a manner that both pages combine to form a spread. A double spread is sometimes called a "two page spread" or a "center spread" (when located in the exact center of a booklet).

DOUBLET.—The duplication in composition of a word, phrase, or sentence. A slug of corrected type inserted in a form without removing the incorrect slug, thus causing repetition.

DOWEL.—A short register pin of plastic or metal attached to a film support or plate; used to position a film or flat for double printing or for step-and-repeat exposure.

DRAW.—The action of a dull knife in cutting paper which draws the sheets away from the backstop of the cutter, thus producing a somewhat concave rather than vertical slice.

DRAWDOWN.—A test for ink color made by placing a small quantity of ink on paper and spreading it (drawing it down) with an ink knife.

DRIERS.—Additives used to accelerate drying of ink.

DRIVER WHEELS.—Small detachable wheels which ride the conveyor tapes and help control the sheet as it travels down the feedboard of the press.

DROPOUT.—Halftone negative in which dots have been eliminated (dropped out) from highlight and background areas by exposure or development.

DRUMS.—Large metal rollers in the inking system of the press.

DRY BRUSH.—A drawing made on rough paper with very little ink in the brush.

DRYERS.—Machines which dry film by the use of squeegee rollers and hot air.

DRY OFFSET.—Offset process using relief plate and no water.

DUBAR.—A trade name for plate lacquer used to strengthen the image.

DUCTOR.—A roller in the inking or dampening system which alternately contacts the fountain and distributor rollers.

DUMMY.—(1) A preliminary drawing or layout showing the position of illustrations and text as they will appear in the final reproduction; (2) set of blank pages made up to show the size, shape, and general style of a book, booklet, or pamphlet; (3) a guide for the stripper in impositioning pages, usually blank sheets of paper folded and folioed to represent the signature of a book.

DUOTONE.—A halftone that has its shadow detail printed in a dark color and its highlight detail in a lighter color.

DUPLICATOR.—A small offset press.

DWELL.—The length of time that a roller is in contact with another roller or cam.

DYCRIL.—A trade name for a relief printing plate; used in letterpress and dry offset work.

DYE-COUPLED DEVELOPER.—A special photographic developer used in color photography. Two images are developed simultaneously in the film: a light, silver image and a darker, dyed image. The silver image is later bleached out, leaving only the dyed image.

ECCENTRIC.—A disk which rotates with an off-center action.

EFFECTIVE APERTURE.—Useful lens area; maximum diameter of lens diaphragm as measured through the front lens element; also known as the "rated aperture."

EJECTOR PINS.—On the Multilith, pins in the impression cylinder which rise automatically to push the paper from under the gripper fingers and out over the stripper fingers.

EJECTOR ROLLERS.—Rollers on the delivery end of the Multilith which force the paper into the paper receiver.

ELECTROSTATIC COPIERS.—Machines which produce plates and paper copies electrostatically.

ELECTROSTATIC PLATES.—A plate produced by an electronic process. See xerographic printing.

ELEMENT.—In chemistry, the basic form of matter which cannot be reduced to different substances by chemical means; also an individual portion of a lens assembly.

ELEVATOR FINGER.—On some folders, a device which regulates the height of the pile in the feeder.

ELLIPTICAL DOT HALFTONE SCREEN.—A contact screen which produces an elliptical dot instead of the conventional square dot.

EM.—A printer's unit of measure, the square of the body of the type; e.g., eight points by eight points.

EMBOSSING.—Swelling of the offset blanket to form a relief image of the printing design due to absorption of the ink vehicle; usually disappears with washing or by evaporation; also pressing an inked or uninked image in relief onto paper stock.

EMERGENCY TRIP.—On offset presses, a handle or button used to throw off the impression and ink.

EM QUAD.—A square space as wide as the point size of the type body.

EMULSIFICATION.—Mixing of water in an inking system or ink in a dampening system; may cause gray image (water in ink) or plate scum (ink in water).

EMULSIFY.—To allow to mix; absorption of water by ink or vice versa.

EMULSION.—Suspension of light-sensitive salts in gelatin or other colloids; used for coating photographic plates and films; also suspension of fine particles of a solid or globules of a liquid in another liquid; e.g., ink globules in the fountain solution.

EN QUAD.—Half the width of an em quad; also called "nut." Properly called a space as it is smaller than an em.

ENAMEL STOCK.—Paper to which has been applied a smoothed coating; may be dull finished or high gloss.

END PAPERS.—Fly leaves at the front and back of a book; used in attaching the cover to the signatures.

ENGLISH FINISH.—Uncoated book stock with relatively high bulk and smooth surface.

ENGRAVED BLANKET.—Blanket dented by pounding from stiff ink; the opposite of an embossed blanket.

ENGRAVING.—(1) A line cut; (2) intaglio or gravure printing plate; (3) blanket dented by pounding from stiff ink.

ETCH.—A chemical treatment of a plate to make nonworking areas grease resistant; also the solutions used to accomplish this.

EXPANSION TRUCKS.—Devices supporting the ends of ink rollers on platen presses which are adjustable to regulate the pressure between the rollers and the type of form.

EXPOSE.—To allow light to enter the camera and strike the film; also to allow the light to strike the plate surface through the goldenrod negative layout.

EXPOSURE METER.—A device used to measure light intensity.

EXTENDERS.—Mostly mineral products of chemical manufacture; used to improve the working qualities of ink.

F-NUMBERS.—Fixed values at which the aperture of the lens can be set. The values are determined by the ratio of the aperture to the focal length of the lens.

FAKE PROCESS.—Process by which color-separation negatives can be made from a set of retouched black-and-white photographs by changing screen angles.

FAN OUT.—Horizontal paper stretch at the trailing corners of the sheet which sometimes occurs as the stock is run through the press.

FARMER'S REDUCER.—A chemical solution used as a silver solvent to remove fog from negatives or positives or to decrease the size of halftone dots, as in dot etching.

FEEDBOARD.—On offset presses, the table over which a sheet travels on the way to the front guides; on platen presses, the table which holds paper to be hand-fed into the press.

FEEDER CLUTCH LEVER.—A lever which engages the clutch and sets the feeder in motion.

FEEDER CONTROL LEVER.—A lever which sets up suction to start sheets feeding and throw on impression on some ATF presses.

FEEDER PLATFORM.—A board or table on which paper is piled for feeding into the press.

FEED ROLLS.—A forwarding device on small presses; used to move stock from front guides into impression cylinder grippers.

FEED TABLE.—A platform on which paper stock is loaded for feeding into presses.

FELT SIDE (OF PAPER).—Smooth or top side; preferred side for printing. See wire side.

FILLING IN (OR FILLING UP).—Filling of areas between halftone dots or small letters caused by excessive or thin ink.

FILM PROCESSOR.—Machine which automatically develops, washes, and fixes film in one continuous operation.

FILM SPEED.—Relative sensitivity of film to light.

FILTER.—A piece of colored glass, film, or gelatin used to separate colors, reduce glare, or vary contrast; also a material, such as cheesecloth, that allows certain dissolved materials to pass while holding back insoluble particles.

FILTER FACTOR.—The number of times an exposure must be increased when using a filter.

FILTER SLOT.—An opening in the lens barrel for insertions of filters and special function stops. See Waterhouse stop.

FIXER.—A photographic solution which stops the action of the developer, dissolves unexposed silver salts in the emulsion, and hardens the colloids; commonly called "hypo."

FLAP SHAFT.—On the Harris press, a series of metal fingers attached to a cam-operated shaft located at the front of the feed pile.

FLARE.—Nebulous patches of light caused by internal reflection in the lens.

FLASH.—A supplementary halftone exposure of short duration made to introduce a fine, pinpoint dot into the shadow areas.

FLAT.—A sheet of acetate or paper on which negatives or positives have been mounted in proper position for printing.

FLATBED PRESS.—A press on which typeforms or lithographic stone rests on a flatbed.

FLAT NEGATIVE.—A negative with little contrast.

FLAT STITCH.—To staple or stitch along the edge; to side stitch. See saddle stitch.

FLOW.—The ability of the ink to follow the fountain roller and level itself.

FLUORESCENT INKS.—Inks that fluoresce or shine.

FLUSH.—Even with the margin or even with the widest line in the column or page.

FOCAL LENGTH.—The distance from the lens to the negative when the camera is focused on an object at infinity (100 feet or more); also one fourth the total distance between the film and copy when a process camera is focused for a same-size reproduction.

FOCAL PLANE.—Position at back of the camera at which the image is focused and the film is placed.

FOCUS.—Point at which light rays passing through a lens meet to form a sharp image.

FOCUSING DIAL.—A device used to calculate proper camera settings for reductions and enlargements; also used to determine proportional dimensions.

FOG.—Silver deposit clouding all or part of the transparent areas of film.

FOLD PLATE.—A narrow metal chute on folder which controls paper as it is buckled to make the fold. A separate fold plate is required for each fold.

FOLD PLATE STOP.—An adjustable bar within the fold plate which can be set to control the width of the fold.

FOLDING BONE.—See bone.

FOLD-INS.—Maps, charts, illustrations, and so on (larger than page size), which are printed separately and then folded and inserted into the signature of a book by hand. Also called "foldout."

FOLIO.—A page number.

FONT.—A complete assortment of type of one size and style.

FORM ROLLERS.—On an offset press, the ink and dampener rollers which contact the plate.

FORMAT.—The size, shape, and general style of the makeup of a publication.

FORWARDING ROLLERS.—On the offset press feeders, the rollers which receive the sheet from the sucker feet and force the sheet onto the conveyor tapes.

FOTO TYPE.—A trade name for cardboard letters used in copy preparation.

FOUNTAIN.—A reservoir for water or ink.

FOUNTAIN BARREL.—A fountain roller.

FOUNTAIN LINERS.—A paper liner for the ink fountain of small presses.

FOUNTAIN ROLLER.—A roller which revolves in ink or water fountain.

FOUNTAIN SOLUTION.—The chemical solution in the water fountain of the offset press; commonly called the "water."

FOUNTAIN TRIP.—See automatic fountain trip.

FRENCH CHALK.—See magnesium silicate.

FRENCH FOLD.—An arrangement in which all of the pages are printed on one side of the sheet, the other side being left blank. The blank side is folded inward before making the other fold, as a greeting card.

FREQUENCY (OF LIGHT WAVES).—The number of light waves generated in one second.

FRICTION FEEDER.—Any feeder that feeds sheets into the machine by means of a revolving wheel or brush which contacts the top sheet of paper and moves it forward.

FRILLING.—The separation of film emulsion from the base along the edges.

FRINGE.—In line and halftone negatives or positives, an extension of the opaque detail into the surrounding transparent areas as a zone of decreasing density; usually microscopic in its dimension, but of sufficient magnitude in camera-exposed negatives to make the dot size or the body weight of characters dependent on the relative time of exposure.

FRISKET.—A stencil used in masking airbrush work; also a mask used in letterpress makeready.

FRONT (OF PRESS).—Delivery end

FRONT GUIDES.—Pins or plates at the end of the feedboard for registering sheets on the press.

FRONT MATTER.—In publication work, that matter which precedes the actual text, such as the title page, the preface, the forward, and the table of contents.

FRONTISPIECE.—An ornamental drawing or illustration facing the title page of a book.

FUSER.—In electrostatic plate making, the heating unit that fuses the image to the plate.

GALLERY CAMERA.—Horizontal camera, not connected to the darkroom.

GAMMA.—Numerical designation for the development contrast of a negative.

GANG NEGATIVE, GANG PLATE.—In photomechanics, a negative bearing a number of properly positioned images and a printing plate made therefrom. A gang negative is also known as a "multiple negative"; multiple negatives are the method of handling many small images as one unit in the step-and-repeat machine; used in lithographic plate making for making multiple images.

GANGING.—A combination of unrelated jobs on a single-press plate to save press time.

GAP.—See cylinder gap.

GATHER.—Assemble printed sheets in proper order.

GEAR STREAKS.—Parallel streaks or slurs across the sheet and at the same interval as gear teeth on the cylinder; caused by difference in surface speed of cylinders. A term improperly applied to all parallel streaks.

GELATIN.—Gluey colloid obtained by boiling animal bones.

GHOST.—Reappearance on the same sheet of an image laid down near the gripper edge and repeated due to improper ink or dampener roller

GHOST IMAGE.—Unwanted gray image picked up by the rollers and repeated farther back on the printed sheet. Negative ghosts appear as a light image in a solid or halftone area; positive ghosts appear as a gray image in the non-image areas of the sheet.

GLAZE.—On ink rollers, a hard, shiny appearance caused by improper cleaning.

GOLDENROD.—Paper or plastic support for negatives; used by the stripper in making flats.

GOTHIC.—Class of type, usually a business-like letter without serifs.

GRAIN.—(1) Texture and compactness of metallic silver particles in the photographic emulsion; (2) direction of alignment of fibers acquired by paper during manufacture; (3) tooth or roughened surface on a metal offset plate.

GRAINING.—Roughening the surface of a metal plate with marbles and abrasives to increase its capacity for holding moisture. Plates may also be grained chemically and with rotating brushes.

GRAY CONTACT SCREEN.—Halftone screen used for both black-and-white and color-separation work.

GRAY SCALE.—A strip of paper containing tones ranging from pure white to black with intermediate shades of gray; used as a tool in contrast control.

GRIPPER EDGE SHEET GUARDS.—Metal fingers which guide or channel the stock into the cylinder grippers.

GRIPPER BITE.—The distance the grippers overlap the press sheet as they clasp it to draw it through the press.

GRIPPER EDGE.—The leading edge of the press sheet; the edge that is caught by the grippers as the paper is drawn into the press; also the leading edge of the goldenrod layout or plate.

GRIPPER MARGIN.—On the goldenrod layout, an amount of space allowed for the grippers to clasp the press sheet.

GRIPPERS.—On offset presses, short, curved fingers which grip the paper and carry it through the printing unit.

GROUND GLASS.—Frosted glass used at the back of the camera in focusing.

GUIDE MARKS.—A method of using cross-line marks on the offset press plate to indicate trim, centering of the sheet, centering of the plate, and so on, as well as press register in multicolor work. Not to be confused with register marks used for stripping elements to register.

GUIDES.—Guides used in positioning or registering paper in the press.

GUM ARABIC.—Dried sap from acacia trees; soluble in water; used to form a protective coating over plates.

GUMMING UP.—Applying a solution of gum arabic to a plate to prevent oxidation and to protect it from damage during washout or makeready operations.

GUM STREAKS.—The streaks produced by improper rubdown during gumming up; particularly noticeable in halftones.

GUTTER.—The inside margin of a bound page extending from the image area to the binding edge.

H AND D CURVE.—See characteristic curve.

HALF TITLE.—The title of the book printed on a page separating the preliminary or front matter from the text. Half titles may also be used throughout a book to separate principle parts of the text.

HAIRLINE RULE.—In letterpress work, a rule producing a fine printing line, approximately 0.003 inch thick.

HALFTONE.—A film, print, or plate in which details and tone values are recorded as photographically created dots.

HALFTONE INK.—Soft, fluid, letterpress ink; used for printing halftones and for reducing stiffer inks.

HALFTONE SCREEN.—See screen.

HALFTONE STEP SCALE.—A series of uniform tint steps of increasing dot diameters photographically prepared on film. Frequently added to a flat and located to print in a trim margin of the press sheet; used as a control to evaluate printing conditions throughout the pressrun.

HALFTONE NEGATIVES.—Photographic negatives made by photographing the copy through a ruled screen. The screen breaks the image into a series of small dots of varying sizes which combine to give the appearance of continuous tone.

HALIDE.—Salts of chlorine, bromine, iodine, or fluorine. These elements are known as "halogens."

HANGING INDENTION.—Style of indention in which the first line is set flush left and the remaining lines of the paragraph are indented.

HANKO DAMPENER.—Cleaning solution for the dampening rollers.

HARD COPY.—An enlarged print made from a microfilm image; also the copy produced on a cold-type composing machine.

HEADLINER.—A photolettering machine.

HEAD MARGIN.—The space between the edge of the image and the gripper edge of the press sheet.

HEATING PROCESSING.—Producing a photographic image which has diazo salts in a synthetic resin emulsion. Development is accomplished by heating the film rather than processing it in chemicals.

HEX NUT.—Hexagonal (six-sided) nut.

HICKEY.—Any imperfection on the press sheet caused by dirt on the press; dried ink on the plate or blanket; picking; or paper dust. A spot (generally having a dark center and white outline) in a halftone or solid area of a print is due to dirty ink.

HIGHLIGHT EXPOSURE.—One of the multiple halftone exposures made when a copy has considerable tonal range.

HIGHLIGHT PRINTER.—In duotone work, the negative for the colorplate, as distinguished from the shadow printer negative which is generally used for the black plate.

HIGHLIGHTING METHOD.—A term applied to a method of producing halftone negatives with a contact screen in which a highlight or bump exposure is used in addition to the flash and detail exposures.

HIGH NEGATIVE.—A dense, very contrasty halftone negative; has no pinhole openings in the darker portions.

HOLD-DOWN BARS.—Metal bars which control the paper as it travels down the feedboard of the offset press.

HOLOGRAM.—A 3-D picture made on film exposed by light from a laser beam; produces a 3-D image which you can see without glasses. See Xograph.

HONE.—An abrasive stick for removing unwanted markings from metal offset plates.

HORIZONTAL CAMERA.—Process camera whose bellows extends horizontally.

HUMIDITY.—A measure of the moisture content of the air. See relative humidity.

HYDROCHLORIC ACID.—An acid used in counteretching some press plates.

HYDROMETER.—An instrument for measuring the density of liquids.

HYDROQUINONE.—A chemical agent in photographic developers; the reducing agent.

HYGROSCOPE.—An instrument for measuring the moisture content in a stack of paper.

HYPO.—See sodium thiosulfate.

ILLUMINATION.—The amount of light that strikes a surface.

IMAGE.—The area of a plate which prints or reproduces.

IMPOSE.—To arrange in the order specified by the copy, dummy, or layout.

IMPOSITION.—A plan for placing the typeforms or negatives in proper order so that pages will be in desired sequence after printing and folding.

IMPOSITION CHART.—A piece of blank paper the size of the sheet to be printed, numbered, and folded as it will be in the bindery after printing; used in makeup to show where each page should go in relation to the other pages.

IMPRESSION.—An inked image printed on paper as it runs through the press; also the squeeze between the impression cylinder and the blanket.

IMPRESSION CYLINDER.—On an offset press, the cylinder that carries the paper into contact with the blanket.

IMPRESSION LEVER.—A lever found on some presses for bringing the cylinders together so that the image will print.

IMPRINT.—To add identification or other copy to a previously printed sheet.

INCHING THE PRESS.—Jogging or rotating the press by degrees.

INDIRECT METHOD (IN COLOR SEPARATION).—A method in which continuous-tone positives are made from the separation negatives. These positives are corrected as necessary and then copied as transparencies in producing the final halftone negatives or positives.

INFERIOR.—A figure or letter which is smaller and lower than other characters in a line of composition.

INITIAL LETTERS.—Large capital letters; used at the beginning of a paragraph.

INK FOUNTAIN.—A reservoir designed to feed the correct quantity of ink to the press rollers.

INK MILEAGE.—Ink consumption on a given job.

INSERT.—In binding, collecting and inserting signatures one into another for saddle-stitched books; also a small negative or picture stripped into a large one.

INSERTION DEVICE.—A device used to move the sheet into the cylinder grippers after the sheet is stopped by the front guides; may be a roller, a transfer cylinder, or swing grippers.

INTAGLIO PRINTING.—The type of printing done from plates which have the image etched below the printing surface as in engraving and gravure.

INTEGRATED TONE DENSITY.—In halftone work, the density or tone created by the halftone dots and the transparent areas around them.

INTENSIFY.—To increase the density or contrast of each silver particle in the film emulsion by adding silver compounds or metals, such as mercury; also to add lacquer to the image on an offset plate.

INTERMEDIATE.—Something used between two stages in the process of production, as a film negative being the intermediate between the camera copy and the photo-offset plate.

INTERTYPE.—A typesetting machine similar to the Linotype.

IODINE QUARTZ LAMPS.—Incandescent light bulbs filled with iodine vapor.

IRIS DIAPHRAGM.—See diaphragm.

ITALICS.—A class of type consisting of slanted letters.

JCP.—The abbreviation for the Joint Committee on Printing, Congress of the United States.

JOB INK.—Letterpress ink used for general work.

JOB JACKET.—A protective covering or envelope used for routing jobs through the shop and for filing them after the work is completed.

JOG.—To jar paper to align sheets and stack them in an even pile; also to inch the press.

JOGGER.—See side guide.

JOGGERS.—Metal plates that move back and forth on the delivery table of the press to keep the stack of printed sheets even.

JOURNAL.—The shaft at the end of the cylinders and rollers; the part that rides in the bearings.

JOURNEYMAN.—A skilled craftsman; one who has finished his apprenticeship.

JUSTIFY.—To adjust the space between words (or letters) to make all lines come out to the same length.

KERN.—A part of the face of a typecast letter that projects beyond the body.

KEY FLAT.—A flat used as a master or guide in stripping other flats of the same job.

KEY PLATE.—The plate used as a guide for registration of other colors; the plate with maximum detail.

KILL.—To cancel.

KISS (PRESSURE).—The minimum pressure at which proper ink transfer is possible.

KNIFE FOLDER.—A folding machine which uses a knifelike bar to start the crease in the sheets.

LAKES.—Organic printing inks made from metallic dye compounds.

LAKETINE.—A general-purpose, strength-reducing material; used with colored lithographic inks for making tints.

LAMINATING.—Bonding a thin sheet of acetate to printed paper.

LAMP BLACKS (INK).—Pigment made from the burning of various oils rich in hydrocarbons.

LASER BEAM.—A narrow beam of coherent

LATENT IMAGE.—A dormant image which becomes visible during film or plate processing.

LAW OF INVERSE SQUARES.—A rule stating that the amount of light of a given light source falling on an object varies inversely as the square of the distance from the source to the object.

LAY.—The correct positioning of subjects on the press plate or printed sheet.

LAYOUT.—Drawn-to-scale plan for the makeup of a printed sheet.

LAY SHEETS.—Sheets run during make-ready in setting up the press.

LEADING.—The forward or top edge of a sheet, plate, blanket, etc., as the gripper edge.

LEDGER.—A smooth, strong paper which readily accepts printing and writing inks; used for bookkeeping records requiring permanence and frequent use.

LEGEND.—Words entitling, defining, or explaining an illustration in one or more lines below the illustration.

LENGTH (OF INK).—The fluidity or flow of ink.

LENS.—A piece of optical glass or a series of glass elements arranged to focus light rays.

LEROY.—A mechanical lettering set.

LETTERPRESS PRINTING.—Printing from raised surfaces, such as type and cuts.

LETTERSET.—The name applied to dry offset printing from plates having a relief image.

LETTERSPACING.—Inserting a space between each of the letters in a word.

LIFT.—A small stack of paper. The paper is loaded into the cutter, press, and other lithographic machines in lifts.

LIGHT-INTEGRATING DEVICE.—A mechanism which measures the intensity of light falling on sensitized material and automatically alters the timing to ensure that each exposure is

LINE COPY.—A copy, either text or art, suitable for photographing without the use of a halftone screen.

LINE GAUGE.—A rule graduated in picas; used by printers for taking measurements.

LINE NEGATIVE.—A negative made from line copy containing only solid blacks and whites.

LINEN TESTER.—A fixed-focus magnifier.

LINSEED OIL.—An oil obtained from the seed of the flax plant. A drying oil used in mixing inks. Boiled linseed oils are called "varnishes."

LITHOGRAPHIC NEEDLE.—A negative engraving device.

LITHOTINE.—A lithographic solvent.

LITMUS PAPER.—A paper coated with a dye that turns red in contact with acid and blue in contact with a base.

LONG INK.—Ink that is stringy like molasses.

LONG SCALE FILM.—Film having an emulsion that will record a wide range of tones.

LOW NEGATIVE.—A halftone negative that is too thin with no opaque pinpoint dots in the shadows.

LOWERCASE.—Small letters as distinguished from the capitals or uppercase.

LUMINOUS.—Light-generating objects.

LYE.—Sodium hydroxide. See caustic soda.

M.—Designation for 1,000 sheets or impressions.

MACHINE DIRECTION.—The direction of the grain in paper as determined by the forward motion or flow of the paper machine; also called "grain direction."

MAGENTA.—Cold, bluish red.

MAGENTA CONTACT SCREEN.—A magenta-colored contact screen; used for making halftone negatives.

MAGNESIUM SILICATE (FRENCH CHALK).—Powder used to relieve tackiness of offset blankets; also used in plate making. Talcum powder is a form of magnesium silicate.

MAGNETIC INKS.—Inks that contain iron-oxide pigments that can be magnetized and read electronically.

MAKEREADY.—Preparation of the press to obtain the proper printing impression.

MAKEUP.—Arrangement of type and cuts into columns and pages by the printer.

MARGIN LINE.—A line ruled on a layout to denote the limits of the work on the page.

MARK UP.—To write up instructions, as on a dummy.

MASH.—A depression or rupture of the blanket surface caused by folded, creased, or rumpled sheets going through the press; also called "smash."

MASK.—To protect areas of a sensitized film or plate from exposure to actinic light by the use of such materials as goldenrod or red paper, aluminum foil, etc; also a controlled, low density continuous-tone positive or negative used to correct the tone range or color errors in a negative in color-separation work. The negative and its mask are registered together and then photographed as a unit when making a corrected halftone positive.

MASKING.—Protecting or blocking out parts of the copy or negative; also a color-correction method used in process color work.

MASTER.—An original from which copies can be made, as a direct-image plate.

MASTER GRIPPER.—On the Harris offset press, a delivery gripper which controls the location of the gripper opening cam roller lever.

MATTE-FINISH.—In photography, photos having a rough or textured surface, as opposed to a glossy finish; on acetate, a frosted or ground glasslike appearance.

MECHANICAL.—Pasteup of the job with repros pasted in place and rules and reverses drawn in with guidelines to show where artwork is to be stripped in or job is to be broken for color.

MELLETON.—Cloth covering used on the dampening rollers of the offset press.

MERCURY-VAPOR LAMP.—An enclosed light source containing mercury; sometimes used to expose plates or as an illuminant for cameras.

METALPHOTO.—A trade name of photosensitive aluminum plate material (and processing chemicals); used for making aluminum nameplates, plaques, instruction panels, or similar items.

METER UNITS.—The connections at the end of the oil tubes on the larger ATF presses and some Harris presses.

METER-CANDLE-SECOND.—A unit of exposure; used in making sensitometric measurements of film emulsions in preparing characteristic curves; equal to the exposure produced by a light source of one candlepower in 1 second at a distance of 1 meter from the sensitive surface.

METOL.—A chemical agent in photographic developers; an energetic reducing agent.

MICRO-FLO DAMPENERS.—Water-to-ink dampening system found on some Harris presses.

MICROMETER.—A precision instrument; used for measuring the thickness of the plate and blanket.

MIDDLETONE.—Any of the various tones in photographic copy ranging between black and white; also a halftone exposure.

MOIRE.—A disturbing dot formation caused by rescreening a printed halftone at an improper screen angle.

MONOCHROME COMBINATION.—In presswork, a two-color job, one of the colors being a dark color and the other a tint of the first,

MONOCHROMATIC FILM.—A film whose emulsion is sensitive to the blue and violet end of the spectrum only; also called "regular" or "blue-sensitive film."

MONOTYPE.—A typesetting machine which sets lines of individual letters, as compared to slugs produced on the Linotype.

MONTAGE.—See photomontage.

MOTTLING (OF INK).—Dirty or speckled appearance of print due to dirty ink, nature of ink pigment, insufficient printing pressure, excess tack, or excess cutting of ink.

MOURNING BANDS.—Ink pigment adhering to melleton dampener covers in the form or a ring or band, usually on the ends of the rollers.

MULLEN DAMPENING SYSTEM.—A dampening system for offset presses in which water is fed to the plate directly from the dampener fountain roller, and the excess water is drawn off by a vacuum unit before the plate reaches the ink rollers.

MULTICOLOR PRESSES.—Presses capable of printing more than one color in a single run.

MULTILITH.—A trade name for a small offset press.

MULTIPLE-SHEET CHOKE.—See caliper.

MUNSELL COLOR MATCHING SYSTEM.—System used in matching colored inks.

NAP.—Rough, fibrous surface of cloth, like that found on towels.

NEAR SIDE.—Operator's side of press.

NEEDLE.—Steel points of various cross-sectional shapes (square, round, oval, etc.) encased in a pencil-like wooden holder; used to make, scrape, or engrave film or press plates.

NEGATIVE-WORKING PLATE.—Photo-offset plate that has a light-sensitive coating which

NEWS INKS.—A soft, fluid letterpress ink suitable only for absorbent papers.

N. F.—Abbreviation for National Formulary.

NCR PAPER.—"No carbon required" paper manufactured by the National Cash Register Co., having a chemical coating on the back of one sheet which combines with the coating on the front of another sheet to produce a duplicate copy on the second sheet when pressure is applied to the first.

NIGHT LATCH.—On some presses, the lever used to release tension on ink or water rollers during long press shutdown periods.

NITRIC ACID.—Acid used diluted as a counteretching solution.

NONPAREIL.—Printer's unit of measure; six points; also a term applied to six-point type.

NONWORKING AREAS (OF PLATE).—The non-image areas.

NOTCH.—Half "V" cutouts along the margins of a goldenrod flat to locate the gripper line and center line of the flat in plate making.

NUMBERING MACHINE.—An attachment for an offset press that prints a consecutive number with each impression.

OFFSET (ALSO CALLED SETOFF).—The transfer of ink from a freshly printed sheet to the back of another when they are stacked together; also a form of lithographic printing.

OFFSET PAPER.—Book paper made for offset printing. Offset paper may be printed by letterpress, but not all book papers may be printed by offset.

ONE-TO-ONE SHOT (1/1 OR 1:1 SHOT).—See same-size shot.

ONE-STEP SOLUTION (PLATE MAKING).—Solution in which the lacquer and gum are combined so that both can be applied in the same operation.

OPAQUE.—A substance used to paint out areas of negatives.

OPACITY.—A direct measurement of the extent that a photographic image will prevent the passage of light. Opacity is the reciprocal of the percentage of light transmitted. Density is the natural logarithm of opacity.

OPEN.—Slightly underexposing and developing a halftone negative so that the dots will be slightly smaller than those normally obtained. An open negative will result in a fuller or darker-printed illustration.

OPEN PRESS.—Hand-fed platen press.

OPTICAL CENTER.—A spot which the eye first strikes when viewing a page. About two fifths of the way from the top and slightly to the left of the actual center.

ORGANIC.—A term used by chemists to indicate that a substance consists primarily of compounds of carbon in conjunction with a few other elements.

ORIGINAL.—A copy submitted to the printer for reproduction.

ORTHOCHROMATIC.—A term applied to photographic emulsions which are sensitive to green, blue, and ultraviolet light.

OSCILLATING ROLLERS.—Rollers which move back and forth sidewise as they rotate.

OSCILLATING SUCTION HEAD.—On some models of the Harris press, a revolving suction wheel which picks up the sheet and forwards it to the conveyor tapes.

OUTLINE HALFTONE.—A halftone from which the background has been cut away or eliminated.

OVERBURN.—Double burn on the plate.

OVERFEED.—A buckle in the sheet, formed when edge of stock is forced against the cylinder pins or grippers.

OVERLAY.—A sheet of acetate or tracing paper fastened over the original copy to indicate position and color of various elements.

OVERPRINT.—In plate making, the exposure of a second negative on an area of the plate previously exposed to a different negative. A method of combining a line and halftone image on the plate.

OXIDATION.—Corrosion or rust. Slow drying will cause some press plates to oxidize.

OZALID MACHINE.—A trade name for an ammonia process print-making machine which produces same-size copy from translucent or transparent originals on diazo-coated paper.

OZALID PAPER.—See diazo paper.

PACKING.—In offset work, the sheets used behind the blanket or plate.

PACKING-DOWN.—A gradual decrease in gauge of blanket from when first put on the press that requires repeated additions of underpacking; also called "sinking."

PADDING CEMENT.—A rubbery substance used in binderies for padding books.

PAGE SPREAD.—Two adjacent pages creating a single unit for the reader, as an illustration covering two facing pages.

PAKOROL G.—A film processor manufactured by the Pako Corporation.

PANCHROMATIC.—A term applied to photographic emulsions which are sensitive to all colors of light; their range of color sensitivity is approximately equal to that of the human eye.

PANTONE.—A color-matching system used in mixing or procuring colored inks.

PAPER CONDITIONING.—Paper treatment to match conditions from storage to pressroom.

PAPER DAMPENER COVERS.—Parchment covers used on dampening rollers in place of cloth coverings.

PAPER GRAIN.—The position of fibers in the paper.

PAPER NEGATIVES.—Negatives having a lacquered or transparentized paper base.

PAPER PLATE.—See direct-image plate.

PAPER RECEIVER.—Delivery unit on smaller offset presses.

PAPER STOP BAR.—Fingered metal bar found at the end of the feedboard on some presses for stopping the paper before it is caught by the cylinder grippers.

PARALLEL FOLDS.—One or more folds made in the same direction, as an accordion fold.

PARALLEL RULE.—Double hairline rule.

PARALLELING THE CYLINDERS.—Adjusting two cylinders so that they come together with equal pressure at both ends.

PASTE DRIER.—Lead or manganese resinates or linoleates ground in a varnish; used mainly as a drier for colored inks.

PASTER.—An attachment used on the folding machine for pasting up booklets.

PASTEUP.—Assembly of all elements in proper position before photographing.

PAWL.—A sliding pin which drops in the notches of a ratchet wheel so as to permit motion in only one direction.

PEGBOARD.—A mechanical system for positioning a set of negatives or positives to produce a flat. Each film is perforated with two or more holes that are referenced to the location of the printing design and its trim margins. The films are positioned over pins that are permanently located in large plastic or pressboard sheets according to the standard layouts or signature arrangements. They are then taped together to form the flat.

PENCIL.—A narrow cylinder of light.

PENETRATION (INK DRYING).—Drying by absorption into the material.

PENUMBRAL.—Shadow halftone theory.

PERFECT (OR ADHESIVE) BINDING.—Binding where pages are fastened by adhesive, as in the case of a telephone directory.

PERFECTING PRESS.—Press capable of printing on both sides of the sheet in a single run.

PERFORATING.—Piercing the paper with a series of tiny dots or slits.

PERFORATING BLADE.—Washerlike perforating blade (similar to the cutting blade); used on the folding machine.

pH (HYDROGEN ION CONCENTRATION).—The degree of activity of acid or alkali in a solution.

PHOSPHORIC ACID.—Acid used in plate etches and fountain solutions; issued in 85 percent concentration.

PHOTOCOMPOSITION.—The photographic composing of text matter through the operation of a keyboard. This directly or indirectly exposes the characters from photomatrices onto photographic film or paper.

PHOTOCOMPOSING MACHINE.—Machine used in commercial plants for step-and-repeat work.

PHOTOELECTRIC SCANNER.—Electronic machine capable of producing continuous-tone or halftone negatives or positives or letterpress cuts from original copy mounted on a cylinder and scanned with an electric eye. Scanners are also used for producing color-separation work.

PHOTOENGRAVING.—Etching metal plates to cause the image area to stand in relief; also a term applied to a cut made by this process.

PHOTOLETTERING MACHINES.—Composing machines using a photographic process for turning out finished lettering.

PHOTOMONTAGE.—A composite picture made from separate photographs pasted together.

PHOTO-RESIST PLATES.—Grained zinc or aluminum plates coated with an organic plastic solution.

PHOTO TYPE.—See foto type.

PHOTOTYPESETTING MACHINE.—Composing machine that produces type composition by photographic methods.

PI.—Spilled type.

PICA.—Printer's unit of measure; one-sixth of an inch or twelve points. See points.

PICA GAUGE.—Same as line gauge.

PICKING.—Lifting of particles of the paper by the blanket due to excessive tackiness of the ink.

PIGMENT.—The ingredient that gives ink its color.

PILE FEEDER.—A type of feeder found on some presses and folding machines. Cut sheets are stacked on the feed table and are fed into the machine a sheet at a time by suction feet or a rotating suction wheel.

PILE HEIGHT GOVERNOR.—A device which controls the height of the paper stack as the stock is fed into the press or folder.

PILING (INK).—Ink buildup on the blanket instead of transferring to the paper.

PILING BARS.—Bars at the sides or corners of the feed table of the press; used for steadying feed pile and as a guide in reloading the press during a run.

PINHOLES.—Small transparent holes or specks in the opaque portions of a negative, generally due to air bubbles during development or to dust on the film, screen, or lens during exposure; can sometimes be eliminated by extended development.

PITCH DIAMETER.—The rolling diameter of a gear.

PLANE.—A flat surface. In lithography, the copyboard is often referred to as the "copy plane," the lensboard as the "lens plane," and the camera back as the "focal plane."

PLANOGRAPHY.—A form of lithography.

PLASTIC BINDING.—A patented bookbinding process.

PLATE.—In offset work, the grained zinc or aluminum sheet carrying the image.

PLATE CYLINDER.—The cylinder on a rotary press to which the printing plates are attached.

PLATE TIGHTENING DIAL.—A device found on some presses for drawing the plate taut on the cylinder.

PLUCKING.—See picking.

PLUGGING.—Filling in of halftone shadow areas in developing the negative or in printing.

PLY.—Refers to the number of layers of fabric in the blanket's construction; also a term used to express the "thickness" of card stock, bristols, or blanks.

POINT.—Printer's unit of measure; one seventy-second of an inch. Twelve points equal one pica.

POLAROID SCREENED PRINT.—A halftone photographic print, made with a Polaroid camera having a halftone screen inserted between the lens and sensitive material. Prints are generally pasted together with line copy and shot as line copy in making the final lithographic plate.

POLYFIBRON BLANKET.—A blanket consisting of two separate parts: a fabric base and an adhesive-backed rubber surface. The base is attached to the plate cylinder, and the layer of rubber is then rolled onto the base under pressure. It is possible to change the rubber layer without removing the fabric base.

POLYMERIZATION.—An ink-drying process in which the molecules of ink become bound together in a matte-line pattern to resist rubbing.

POLYMETAL PLATES.—See bimetal and trimetal plates.

POP.—To give a bump exposure.

POSITIVE-WORKING PLATE.—A photo-offset plate that has a light-sensitive coating which produces a positive image when exposed in contact with a film positive.

POTASSIUM CYANIDE.—Poisonous salts used for wet-plate reduction and for local removal of the albumin image from the press plate.

POTASSIUM FERRICYANIDE.—Salt used in preparing photographic reducers and blueprint solutions.

POWDERING.—The practice of dusting a blanket with powder after washing to offset tackiness; also used to describe ink that dries but pigment does not hold to stock; sometimes called "chalking."

PRECIPITATE.—A solid substance thrown out of a solution by physical or chemical reaction.

PRECIPITATION (INK DRYING).—A group of inks that contain solids that cannot coexist with water. Inks drying by precipitation are steam set.

PRESENSITIZED PLATE.—A precoated plate which can be printed photographically from line or halftone negatives.

PRESERVATIVE (PHOTOGRAPHIC).—A chemical which controls developer oxidation (as sodium sulfite).

PRESSBOARD.—A tough, springy cardboard used for packing on platen presses.

PRESSURE-TRANSFER LETTERING.—Lettering printed on acetate sheets which will transfer to a sheet of drawing paper when rubbed on the back.

PRIMARY COLORS.—The primary colors for additive combinations consist of blue-violet, yellow-green, and red-orange light, and the secondary colors consist of blue-green (cyan), yellow, and magenta. Color scientists consider these secondary light colors to be the true primary pigment colors instead of the traditional red, yellow, and blue, and these colors are used by printers as the basis for mixing colored inks and for process color work.

PRINTER.—A processed lithographic plate. Each plate in a multicolor job is described according to the color it will print, such as the "blue printer" that will be printed on the press with blue ink.

PROCESS CAMERA.—A copying camera used in reproduction work.

PROCESS COLOR.—A loose term for "full-color printing."

PROCESS PRINTING.—Printing halftones in full color.

PROGRESSIVE COLOR PROOFS.—A set consisting of one single-color proof of each printer (plate) and one full-color proof; also called "process color proofs" or simply "color proofs."

PROJECTION PRINTER.—Photographic enlarger.

PROOF.—A trial printing impression for correcting errors.

PROOFREADING.—Checking proofs against copy to assure the accuracy of composition and all details of typography.

PUMICE STONE.—An abrasive used for polishing.

PUNCH REGISTER SYSTEM.—A system involving the use of prepunched holes in the flat and plate and a set of plastic pins or buttons which are used in registering succeeding flats, positioning the image on the plate, and positioning the plate on the press.

QUIRE.—Paper measure, 24 sheets.

QUOIN-TYPE PLATE CLAMPS.—A type of plate clamp used on some ATF presses.

RAG PAPER.—High-grade paper made from rags.

RATCHET WHEEL.—A wheel having teeth which are engaged by a pin that permits motion in only one direction. See pawl.

RAY.—The smallest portion of light, generally represented by a straight line.

REAM.—Technically 20 quires or 480 sheets; commonly 500 sheets. A printer's perfect ream is 516 sheets.

RED PRINTER NEGATIVE.—In color-separation work, a negative made through a green filter. The plate made from this negative is run on the press in red ink.

REDUCER.—(1) Varnishes, solvents, or oily or greasy compounds used to soften the consistency of ink or varnish; (2) in photography, the term refers to chemicals used to reduce the density of negative or positive images or halftone dots; (3) a substance which robs another of oxygen.

REDUCING.—The process of decreasing or clearing fogged areas of a negative.

REFERENCE MARKS.—Registration marks.

REFLECTION COPY.—Any copy that is photographed by light reflected from the copy into the camera. Includes all types of opaque copy. See transmission copy.

REFLEX NEGATIVE.—A diffusion-transfer negative, produced by contact printing.

REFRACTION.—The bending of light rays as they pass through a transparent medium, such as a lens or water.

REGISTER.—Agreement in location of successively printed images.

REGISTER MARKS.—Marks, usually crosses, placed on original art or photographic negatives or positives to aid in positioning the images in multicolor or double printing; also called "cross marks" or "reference marks."

REGISTER RULE.—A device used for checking register on printed sheets.

REGISTER TABLE.—That part of the folding machine that corresponds to the feedboard on the offset press.

REGULAR FILM.—A film having a color-blind emulsion.

RELATIVE APERTURE.—The ratio of the lens opening to the camera extension.

RELATIVE HUMIDITY.—The percentage of saturation of a unit of air. A relative humidity of 40 percent indicates that the air contains 40 percent as much moisture as it could carry at that temperature.

RELIEF PLATES.—In offset printing, the plates having an image etched slightly in relief, as Dycril plates. All letterpress plates are relief plates.

REPRO.—A term used to describe a page of reproduction copy, as a repro proof.

REPRODUCTION PROOFS.—Proofs which are to be copied with the process camera for use in making plates or cuts.

RESCREENER.—A diffusion filter; used in copying halftone clippings to diffuse old halftone dots and eliminate danger of moire.

RESIN.—A solid or semisolid substance used to strengthen plate images.

RESOLVING POWER.—The ability of the film or lens to reproduce thin lines without loss.

RESPI HALFTONE SCREEN.—A gray or magenta contact screen which produces a double dot on the negative. Respi screens are also available in glass.

RESTRAINER.—A chemical agent added to retard the action of the developer.

RETICULATION.—A network of cracks in the film emulsion, produced by highly alkaline developing solutions or by forced drying.

RETOUCHING.—The process of painting in details, painting out backgrounds, etc., in photographic copy.

REVERSE.—Anything that is negative in tone value to the original copy. See solarization.

REVERSAL.—See solarization.

REVERSE COMBINATION.—White lettering against a dark background.

RIDER ROLLERS.—Metal or plastic rollers in the inking mechanism which break down, transfer, and distribute the ink.

RIGHT-ANGLE FOLD.—A second fold made at a right angle to the first (parallel fold) in the folding machine.

ROLLER-OPERATED FOLDER.—A type of folding machine operating with a series of metal folding rollers. See knife folder.

ROLLING UP.—Applying ink to the press plate with a hand roller.

ROMAN.—Class of type with open, clean cut letters and serifs; vertical type, as distinguished from italics.

ROUTING.—Cutting away high metal in non-image areas of a relief letterpress cut; usually done with a routing machine.

ROSS BOARD.—An illustration board with a pebbled or roughened surface.

ROTARY PRESS.—A fast press using curved printing plates and a curved impression cylinder.

ROTOGRAVURE.—A mass production gravure (intaglio) printing process using a rotary press.

ROUGH.—A layout in preliminary, rough form.

RUBBER CEMENT.—Pure rubber dissolved in benzol.

RUBBER SHOES (TIPS).—Rubber tips placed over the regular metal sucker feet to provide greater traction in feeding the sheets into the press.

RUB UP.—Applying a liquid ink to all or part of a press plate with a rag or wiper; used to restore ink receptiveness.

RUBYLITH.—See Ulano Rubylith.

RULING.—The number of lines per inch in a halftone screen.

RUN.—The number of copies to be printed on a particular job.

RUNAROUND.—Typeset to fit around an illustration in a column.

RUNNING HEAD.—Publication or chapter title appearing at the top of the pages in a publication.

RUNNING SAFE.—Leaving the offset press with the plate cylinder gap facing the dampeners during shutdown periods.

RUNNING TRUE.—During makeready operations, allowing the press to run until the water and ink have worked out to an even feed.

RUNOVER.—To carry words from the end of one line to the beginning of the next.

SADDLE STITCH.—To bind a publication along the center fold.

SAFELIGHT.—A colored light used for darkroom illumination.

SAFETY PAPERS.—Stock used for printing bank checks, money orders, etc., to prevent alteration.

SALT.—A compound formed when the hydrogen in an acid is partly or wholly replaced by a metal. The names of salts of "ous" acids end in "ite"; salts of "ic" acids end in "ate" with a few exceptions.

SAME-SIZE SHOT.—A term used to describe a negative image that is the same size as the original copy.

SANS SERIF.—A term applied to all typefaces having no serifs; also the name of a particular face of type.

SCALE.—A linear measuring instrument, as a gray scale, halftone step scale, and so on.

SCALING.—A simple plan for proportional reduction or enlargement of copy.

SCORE.—To break or dent the stock so that it can be folded easily.

SCORING BLADE.—A washerlike blade used for scoring sheets on the folding machine.

SCRATCHBOARD.—A drawing board with a smooth clay surface. The artist generally inks the entire board and then scratches in a reverse (white on black) drawing with a sharp instrument.

SCREEN.—A device used for breaking continuous-tone copy into a series of small dots when producing halftone negatives; may consist of a ruled pattern on a glass base or a pattern on an acetate base; also, a term applied to photographing copy through a screen.

SCREEN ANGLE.—The angle of the ruling on the screen. The rulings on rectangular glass screens are made at a 45-degree angle (from vertical) because this angle makes the dot pattern less noticeable to the eye. In color work, the angle must be changed for each color-separation negative so that the dots will not overlap when the job is printed. A glass circular screen is used for this purpose since it permits adjustments for the screen angle. Contact screens are normally ruled at a 45-degree angle. Sets of contact screens (each with a ruling at a different angle) are available for color-separation work.

SCREEN COMPENSATOR.—A sheet of glass having the same refractive qualities as the glass halftone screen; used in the camera during the exposure for the line portion of combination negatives.

SCREEN DISTANCE.—See screen separation.

SCREENING.—Photographing through a halftone screen.

SCREENLESS LITHOGRAPHY.—A method whereby a continuous-tone effect is created on the printing plate without the use of a halftone due to the distribution of the coating thickness formed by the random peak-and-valley structure that vary in size on the plate.

SCREEN SEPARATION.—The distance between the screen and the film, measured in sixty fourths of an inch.

SCREEN TINT.—A halftone film having a uniform dot size over its area and rated by its approximate printing dot size value as 40 percent, 50 percent, etc.

SCRIBER.—A pencil-like tool with a shaped point; used to engrave through the emulsion of a negative in engraving rules or adding other fine printing detail.

SCRIPT.—A class of type that resembles handwriting or hand lettering.

SCUM.—A film of ink accepted by the nonprinting areas of the plate, generally localized. See toning.

SEASONED.—Paper which has been brought to proper moisture balance.

SECONDARY COLOR.—Color formed by mixing two primary colors.

SELECTRIC TYPEWRITER.—AN IBM electric typewriter with a type font in the form of a metal ball which skims across the page to bring the proper character into printing position. Typefaces are interchangeable on these machines, but they do not have proportional spacing.

SELF-COVER.—A term applied to a cover printed in the same signature or on the same stock as the paper used for the text of the booklet.

SENSITIVITY GUIDE.—A strip of continuous-tone film with 21 numbered gradations or density steps which is stripped into the flat along the gripper edge so that it will print on the plate but will not print on the paper when the job is run. When the plate is exposed, the coating under the scale is overexposed at one end and underexposed at the other. The plate maker can regulate exposures by exposing so that a predetermined number of the steps on this scale will print solid on the plate.

SENSITIZED.—Any material coated with an emulsion that is sensitive to light.

SENSITIZER.—A term applied to any material which renders another material or surface sensitive to light.

SENSITOMETRY.—Light-sensitive characteristics of photographic materials.

SEPARATION NEGATIVES.—Negatives made through appropriate filters. Each carries densities representing the value of one of the primary colors; used in full-color printing.

SEPARATOR FINGER.—A metal finger or wire which rides the edge of the paper stack (in the press feeder) to prevent more than one sheet from being pulled into the press at a time.

SHADING SHEET.—A transparent sheet with a uniform pattern of dots or other shapes; used in the preparation of artwork and camera copy.

SHADOW.—The darkest areas of copy; the lightest areas of negative.

SHADOW AREAS.—The darkest parts of a photograph; the lightest parts of a halftone negative.

SHADOW PRINTER.—The negative used for printing the black plate in duotone work. See highlight printer.

SHEET DETECTOR.—A device which kicks off the impression and ink and, in some cases, stops the feeder when a sheet fails to feed through the press.

SHEET-FED PRESSES.—Presses which take sheets rather than rolls of paper.

SHEET-FLATTENING BAR.—A bar which drops on the sheet to prevent it from buckling when it is positioned by the side guide; sometimes called a "corrugating bar" on Harris presses.

SHEET GUARDS.—Long metal strips which hold down the sheet as it is being carried down the feedboard.

SHEET LINE.—A line drawn on the goldenrod to show where the sheet will strike in relation to the plate as the paper travels through the press. The area between this line and the gripper edge of the layout is known as the "gripper plate margin" or the "cylinder clamp margin."

SHEETWISE IMPOSITION.—Imposition which allows the sheet to be printed on one side from one form and on the back from a different form. The same gripper and side guide are used on both runs through the press.

SHELF LIFE.—The period of time before deterioration renders a sensitized material unusable.

SHELLAC.—A varnishlike solution which dries very rapidly.

SHORT INK.—Ink of a lardlike consistency.

SHORT SCALE FILM.—Film having an emulsion that records a limited range of tones.

SHORT-STOP BATH.—A dilute solution of acetic acid and water; used between the developer and fixer in film processing to neutralize the alkali of the developer which otherwise would be transferred to the fixer.

SHOW-THROUGH.—The condition where printing on one side of a sheet can be seen from the other side.

SHUTTER.—A mechanical blade which may be opened to admit light to the camera or closed to shut it out; used to regulate the length of exposure.

SIDE GUIDE.—A registering device which shoves or pulls the sheet sidewise to the proper registering position just before the impression is made.

SIDE GUIDE BAR.—The bar to which the side guide is attached. When the press is in operation, this bar moves back and forth toward the center of the feedboard.

SIDE STITCH.—To flat stitch along the edge of a booklet.

SIGNATURE.—A sheet having a number of pages printed on both sides, usually in multiples of four.

SILHOUETTE HALFTONE.—An outline halftone.

SILK-SCREEN PRINTING.—A type of printing done by squeegeeing paint through a piece of silk stretched taut on a wooden frame. The nonprinting areas are blocked out or masked off so that only the image areas print.

SILVER BROMIDE.—A light-sensitive salt used in photographic emulsions; generally used for enlarging papers.

SILVER CHLORIDE.—A light-sensitive salt used in photographic emulsions; generally used for contact papers.

SILVER IODINE.—A light-sensitive salt used in photographic emulsions to modify sensitivity of other salts.

SILVER NITRATE.—A compound used for sensitizing wet-plate emulsions.

SILVER PRINT.—The photographic proof on silver chloride paper. It produces a brownprint; also called "Van Dyke."

SIZING (OF PAPER).—The treatment of paper to resist penetration of writing or printing ink.

SKELETON CYLINDER.—A series of evenly spaced disks or segments around which the paper travels as it is caught by the delivery grippers and carried to the delivery stack.

SKID.—A wooden platform on which paper is stacked in the pressroom or bindery.

SKID ROLLERS.—On the Multilith, the rollers which control the sheet as it is carried down the feedboard.

SLIP SHEET.—To place a blank piece of paper on top of each printed sheet as it comes off the press to prevent ink from offsetting.

SLOWDOWN MECHANISM.—A device found on some offset presses which slows the sheets down just before they reach the front guides.

SLURRED.—An impression that is blurred or smudged due to improper pressure.

SMALL CAPS.—Letters having the form of capitals and the height of the body of lowercase letters; used in text to show emphasis.

SNAKE SLIP.—An abrasive stick used for removing spots and unwanted lines from the offset plate.

SODIUM BICARBONATE (BAKING SODA).—A mild alkali used to assist plate development.

SODIUM CARBONATE.—An accelerator for photographic developer.

SODIUM HYDROXIDE (CAUSTIC LYE).—A powerful alkali used to remove old images from press plates; may also be used in washing glazed rollers.

SODIUM SULFITE.—A preservative for photographic developers (in anhydrous state).

SODIUM THIOSULFATE (HYPO).—A salt whose water solution dissolves the silver halides. It is used to remove the silver salts remaining in film and paper after development.

SOFT.—Low photographic contrast; halftone dots or fine printing detail with noticeably vignetted edges.

SOFT INK.—A term used to describe the consistency of lithographic inks; a long ink.

SOLARIZATION.—Overexposure of film to the point that further increases in exposure actually result in less rather than more density in the negative.

SOLENOID.—The coil that surrounds a movable core of soft iron. When current is applied, the core is pulled up to a central position in respect to the coil, and it returns to its original position when the current is discontinued.

SPECIFIC GRAVITY.—The ratio of density of a material to water.

SPEED (EMULSION).—The degree of sensitivity to light.

SPEEDBALL PEN POINT.—The artist's lettering pen point.

SPECULAR LIGHT.—The light waves reflected in only one direction.

SPHERICAL ABERRATION.—Poor central definition caused by the curved surface of the lens.

SPIRAL BINDING.—A patented bookbinding process.

SPLIT FOUNTAIN.—Running two or more colors (separated by dividers) in the ink fountain of the press at the same time.

SPLIT GEAR.—On some offset presses, a gear composed of two sections held together by locknuts. Each section is set separately to eliminate gear play.

SPOTTING OUT.—Fine opaquing to remove pinholes or other small transparent defects from a negative.

SPREAD.—In newspaper publication, the space which a lengthy story or large ad occupies; also called a "layout."

SQUARE FINISH HALFTONE.—A square or oblong halftone.

SQUARE SERIF.—The name applied to modernistic style of type.

SQUEEGEE.—A device with a blade of rubber or leather for wiping a liquid from a flat surface.

STABILIZATION PROCESSING.—A two-step process for developing film and paper in a matter of seconds. The developing agent is incorporated into the silver emulsion and is released by an activating solution. Development is stopped by another solution called the "stabilizer."

STACKER.—The delivery unit of the folding machine.

STAGING.—Protecting certain areas of the plate from etching operations by painting or stopping out with a protective fluid, such as varnish or shellac.

STAPLING.—See stitching.

STATIC.—An electrical charge sometimes picked up by paper; causes sheets to stick together as if magnetized.

STATIC ELIMINATOR.—An attachment for printing presses and related equipment designed to remove static electricity from the paper to avoid ink offsetting and trouble with the paper.

STATIMATIC REPROGRAPHER.—A trade name for a plate making machine using the electrostatic process.

STAYFLAT.—A nondrying sticky substance similar to the coating on cellulose tape. It is coated on a piece of glass and used to hold film during exposure.

STEP-AND-REPEAT WORK.—Two or more exposures made on the same plate from a single negative by moving it about; also done with a photocomposing machine.

STICK.—A three-sided metal device used by the compositor when the compositor is setting letterpress type by hand.

STITCHING.—Fastening the pages of a book together with wire stitches. Staplers use individual staples while the stitcher is fed from a continuous roll of wire.

STOCK SHEET.—A standard-size sheet which is kept in stock and cut to smaller sheets as required.

STONE.—In letterpress work, a metal or stonetopped composing table on which typeforms are locked for the press. In lithography, a piece of limestone from which the impressions are pulled.

STOP-OUT SOLUTION.—The solution used to make deletions on positive working plates.

STRAIGHT MATTER.—Type composition consisting of line after line set to the same width in the same size and style of type.

STREAM FEEDING.—A term applied to presses in which the sheets are fed through in a continuous overlapping stream instead of being fed through a sheet at a time.

STRIP.—To assemble and fasten negatives or positives in printing position on goldenrod paper or acetate; also to remove a film emulsion from its base.

STRIP-IN.—Same as insert.

STRIPPER FINGERS.—Metal fingers on the delivery end of the press that strip the paper from the delivery grippers.

STRIPPING (OF PRESS ROLLERS).—Refusing to take ink.

STRIPPING FILM.—Film having an emulsion which peels from the base after a few minutes in warm water.

SUBLIMING.—The change of state directly from solid to gaseous.

SUBSTANCE.—Standard by which business papers (bond, ledger, manifold, duplicator, and mimeo) are weighed. Basis is 500 sheets (commercial standard) or 1,000 sheets (government standard), 17″ × 22″.

SUBTRACTIVE COLOR PROCESS.—The process of forming colors by mixing pigments which absorb certain colors and reflect others. See additive process.

SUCKERS.—Vacuum feet used on press for lifting paper and moving it forward.

SUCTION HEAD.—A rotating suction wheel found on some offset presses and on some folding machines. See oscillating suction head.

SUCTION WHEEL.—On the folder, a revolving wheel which forwards the paper to the conveyor tapes.

SULPHITE PULP.—Pulp used in making papers requiring long fibers and high tear strength.

SULPHUR.—A substance sometimes used with French chalk to relieve tackiness of the blanket.

SUMMER ROLLERS.—The hard, composition letterpress rollers used in summer or warm climates.

SUPERIMPOSE.—To position negatives or positives on a new flat that is prepared directly over another flat to obtain exact agreement and registration between them. This is frequently done when stripping up complementary or color flats.

SUPERIOR.—A figure or letter which is smaller and higher than other characters in a line of composition.

SURFACE PLATES.—Plates in which both the image and non-image areas are flush with the plate surface; as albumin or presensitized plates as opposed to deep-etch and relief-image plates.

SURPRINT.—A print from a second negative superimposed over a print from the first.

SUSPENDED PRESSURE.—On the folding machine, a term used to describe rollers set apart to the exact thickness of the signature being folded.

SWING GRIPPER.—An insertion device used for moving the paper stock into the cylinder grippers after it is stopped by the front guides at the end of the feedboard.

TABULAR MATTER.—To typeset in table or statistical form.

TACK (INK).—Stickness or pull.

TAIL BRUSHES.—On the offset press, brushes which ride on the tail edge of the sheet to prevent it from bouncing away when it reaches the front guides.

TAIL GUIDES.—Small metal posts which are set against the back edge of the paper pile.

TAIL WHEELS.—See driver wheels.

TALC (TALCUM POWDER).—See magnesium silicate.

TEFLON ROLLER COVERS.—Transparent, flourocarbon, resinous sleeves; used as covers for the ink rollers on the offset press.

TEST STRIPS.—Small strips of unexposed film; sometimes kept in darkrooms for testing the quality or condition of the hypo; or exposed strips for testing the developing solution.

TEXT.—Main body of a story or publication; also a class of type, such as Old English.

THERMOGRAPHY.—Creating a raised image by using a powdered resin sprinkled on wet ink and swollen and fused by heat.

THICKEN.—To make (a liquid) dense or viscous.

THIN NEGATIVE.—A negative low in photographic density.

THROW-OFF LEVER.—A lever on some offset presses used to throw off the impression when none is desired.

THUMBNAIL SKETCHES.—Small sketches, quickly drawn to determine the best layout for a job or piece of artwork.

TIME-TEMPERATURE METHOD.—Developing film for a specific time in developer at a specific temperature.

TINT.—(1) A light film of ink (scum) spread over the plate, caused by ink bleeding during the run; (2) a reduction of a solid color; the result of adding a color to white; (3) a benday negative produced with the halftone screen; (4) an area covered with a tint pattern.

TINT BLOCK.—A halftone, benday, or solid background; usually in a light color or tint.

TONER.—A liquid containing chemically charged carbon particles which are attracted to the electrostatic image as the paper or plate passes through an electrostatic copying machine. A powder is used instead of a liquid in some machines.

TONING.—Unwanted tone appearing in the non-image areas of a photo-offset due to bright lighting of the plate making area or accidental exposure.

TOOTH.—A pitted or rough surface, as tooth in metal plate or drawing paper.

TRANSFER CYLINDER.—(1) An insertion device or (2) a cylinder used in transferring sheet from one printing unit to another on multicolor presses. See insertion device.

TRANSLUCENCY.—The ability of certain materials to transmit light without being actually transparent.

TRANSMISSION.—The percentage of light permitted to pass through the negative.

TRANSMISSION COPY.—Copy, such as slides and transparencies, which is photographed by light transmitted through (rather than reflected from) the copy. See reflection copy.

TRANSPARENCY.—A positive copy on glass or film in color or in black and white.

TRANSPARENT PROOFS.—Proofs pulled on acetate or cellophane.

TRAP.—Ability of an ink to accept and hold succeeding colors when one color is printed over another.

TRIM LINE.—The line ruled on a layout to denote the limits of the finished page.

TRIMETAL PLATE.—An offset press plate consisting of three layers of metal. The top layer is etched away in the image areas during processing to expose the middle layer which is sensitive to greases. The bottom layer is merely a support.

TUMBLER GRIPPERS.—Type of grippers found on the impression cylinder of some presses.

TURNBUCKLE.—A long metal collar or sleeve with screw threads at the ends for tightening or drawing together two sections of a rod.

TURPENTINE (TURPS).—A semivolatile oil obtained from pine trees and other coniferous trees; used as ink solvent and cleaning fluid. It readily attacks rubber.

TUSCHE.—A liquid, greasy ink; used for handwork and correction on lithographic plates.

TWO-HAND CLUTCH.—A safety device found on some power paper cutters which requires the operator to use both hands when throwing the cutter in gear to make a cut.

TWO-UP.—Two identical printing images on a press plate; usually made by preparing the flat so it can be exposed successively in the two required locations.

TWO-SHEET CHOKE.—See caliper.

TYPE FAMILY.—A group of typefaces which are similar though not exactly alike in design.

TYPE SERIES.—Different sizes of the same typeface.

TYPOGRAPHY.—The art of printing with type, involving the style, arrangement, and appearance of the printed page.

ULANO RUBYLITH.—A trade name for an acetate sheet having a colored coating which can be peeled off in image areas; used as a substitute for goldenrod paper in stripping operations.

UNDERCUT SECTION (OR PRESS CYLINDERS).—A recessed section between the bearers, designed to allow for the thickness of the plate or blanket.

UNDERCUTTING.—(1) Light rays passing through the transparent areas of the negative at a slight angle so that they extend slightly under the opaque portions of the negative, causing thickening of lines and fine detail on the plate or film positive; (2) the action of the fountain solution in disintegrating the image on an offset plate; (3) the action of acid in eating into the sides of the image when a letterpress cut is being etched.

UNDERTONGUES.—Metal sheet rests which extend from below the edge of the feedboard on some offset presses. The front guides are positioned over these tongues.

UPPERCASE.—The capital letters of a typeface.

VACUUM BACK.—A hinged flat metal plate attached to the back of the camera with a series of concentric vacuum channels which hold the film in place by suction during the exposure.

VACUUM PUMP.—A pump which supplies suction and blast for separating and feeding sheets into the automatic press.

VALUE.—When pertaining to color, the measure of lightness and darkness.

VAN DYKE.—See silver print.

VARNISH.—A substance used as a vehicle or base in the making of inks; may consist of boiled linseed oil or resins.

VEGETABLE BLACKS (INK).—A pigment made by calcination of grape husks, wine twigs, wood, old wine casks, and other similar materials.

VEHICLE.—A liquid used to hold pigments together in ink. See varnish.

VERTICAL CAMERA.—A process camera used in reproduction work; so-called because the bellows extends vertically instead of horizontally.

VIBRATING ROLLERS.—See oscillating rollers.

VIGNETTE.—A type of halftone which has softened "feathered" outlines that blend into the surrounding white space.

VISCOSITY.—The measure of resistance of fluid to motion; sluggishness.

VOLATILE.—Readily evaporated when exposed to air.

WALE FLOATING NOZZLE.—Special blast pipes used on some presses.

WALK OFF.—Image disintegrates or fades out on the press plate during the run.

WALKING THE PLATE.—Twisting the plate on the cylinder to straighten the image on the sheet.

WARM COLORS.—Colors, like red, orange, and yellow, which excite the eye.

WARNOLD PROCESS.—A method of diffusing halftone dots on negatives to give a continuous-tone effect when copying halftone clippings.

WASH DRAWING.—A water-color drawing which must be reproduced as a halftone.

WASH OUT.—To remove the ink from the image on the plate with lithotine or other solvent.

WASHUP ATTACHMENT.—A device for washing the rollers without removing them from the offset press.

WATERHOUSE STOPS.—Blades having round- or odd-shaped openings. They may be inserted into the filter slot of the lens and used instead of the lens diaphragm to produce special effects.

WATERMARK.—A design impressed into some types of paper by a "dandy roller" during manufacture. Lettering of a watermark should read from left to right when the job is printed; on U.S. rag bond papers, the eagle should face to the left.

WATER-ON LEVER.—A lever for moving the dampener form rollers to or away from the

WATER STOPS.—Small metal fingers with rubber blades. They are attached to the fountain of some offset presses. When placed against the fountain roller, they squeeze off some of the water and thereby reduce the supply reaching the dampeners.

WATER-TO-INK DAMPENING SYSTEM.—The dampening system found on some presses in which the water and ink are both fed to the plate from the same set of form rollers.

WAVELENGTH (OF LIGHT WAVES).—The distance from a point on one light wave to a corresponding point on the next wave.

WAXING MACHINE.—A machine used for waxing the back of material to be pasted up for camera copy; used instead of rubber cement.

WEB PRESS.—A rotary press that prints from a continuous roll of paper; also called a "web."

WEDGE GAUGE.—A wedge used for determining screen distance and parallelism.

WET-STRENGTH PAPERS.—A paper which retains more than 15 percent of its dry strength when completely wetted with water.

WETTING AGENT.—Chemicals used to promote uniform wetting and drying.

WINDING STOCK.—Jogging stock to introduce a blanket of air between the sheets.

WIPE-ON PLATES.—Plates coated by wiping with a swab of cheesecloth or specially treated cotton saturated with an albumin solution or diazo compound.

WIPES.—Lint-free wiping material in the form of a pad used in plate making operations.

WIRE SIDE.—The rough side of paper stock which was against the wire mesh in the papermaking machine. See felt side.

WORKING AREAS.—The image areas of a lithographic plate.

WORK AND BACK.—See sheetwise imposi-

WORK AND FLOP.—To print the front and back on the same side of a sheet of paper and then flop the sheet top to bottom and back it up from the same plate; same as work and tumble.

WORK AND TUMBLE.—Same as work and flop.

WORK AND TURN.—Same as work and flop except that the printed sheet is turned left to right for backing up.

WORK ORDER.—A specification sheet attached to the job.

WORM SCREW.—A screw having teeth that thread into the teeth of a gear.

WRATTEN.—A trade name for Eastman Kodak filters.

XEROGRAPHIC PRINTING (PRONOUNCED ZERO-GRAF-IC).—The process by which the image is transferred by a light-sensitive electrostatic charge on a special base.

XEROGRAPHY.—An electrostatic duplicating process in which photographic images are recorded on a charged surface and then reproduced on paper.

XEROX.—A trade name for equipment used in xerographic printing.

XOGRAPH.—A 3-D printing process in which you can see depth in the printed image without glasses. See hologram.

ZINC-OXIDE COATING.—Photoconductive material which becomes light sensitive when charged with electricity; used as a plate coating in some electrostatic plate making processes.

ZIP-A-TONE.—A waxed sheet of cellophane on which benday or other shading patterns have been printed; used as a shading medium for line drawings.

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